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An analysis of P-3 Aircraft Service Period Adjustment criteria

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AIRCRAFT SERVICE PERIOD
ADJUSTMENT CRITERIA

by

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Logisticians at NARF's (Naval Air Rework Facilities) presently rely on the qualitative judgment of skilled P & E's (Planners and Estimaters) to determine when depot level maintenance is required on P-3 aircraft. This study focuses on quantifying the management problem of deciding which P-3's to recommend for rework delays under the Navy's ASPA (Aircraft Service Period Adjustment) program. Inspection consistency, precise managerial auditing, and computer-based trend analysis are prospective attributes of a properly tested and instituted quantitative ASPA evaluation. The engineering basis and the economic realities of the P & E's decision are addressed. By exploring current management science methodologies, a practical model patterned after ASPA evaluation methods being tested at NARF Norfolk and at Army Helicopter Depot Corpus Christi is recommended to assist NARF management with this decision.

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An Analysis of P-3
Aircraft Service Period
Adjustment Criteria

by

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ABSTRACT

Logisticians at NARF's (Naval Air Rework Facilities) presently rely on the qualitative judgment of skilled P & E's (Planners and Estimaters) to determine when depot level maintenance is required on P-3 aircraft. This study focuses on quantifying the management problem of deciding which P-3's to recommend for rework delays under the Navy's ASPA (Aircraft Service Period Adjustment) program. Inspection consistency, precise managerial auditing, and computer-based trend analysis are prospective attributes of a properly tested and instituted quantitative ASPA evaluation. The engineering basis and the economic realities of the P & E's decision are addressed. By exploring current management science methodologies, a practical model patterned after ASPA evaluation methods being tested at NARF Norfolk and at Army Helicopter Depot Corpus Christi is recommended to assist NARF management with this decision.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

A. BACKGROUND

Evaluating an aircraft's overall material condition is like giving a physical examination to a patient. The diagnostic skills of an experienced medical doctor include historical research, visual inspection, physical manipulation, simplified testing, and symptomatic analysis. Once a physical examination is completed, the medical doctor may request additional laboratory tests or exploratory surgery to complete his or her diagnosis.

The diagnostic methods of a NARF (Naval Aircraft Rework Facility) P & E (Planner and Estimator) are not unlike those of a medical doctor. Armed with an abundance of maintenance experience on a particular type of aircraft, a P & E searches the maintenance action files for trends which usually precede major deterioration that is best repaired at a NARF. Next the P & E climbs aboard the aircraft and notes telltale signs of damage on exterior surfaces and inside accessible cavities. Excessive leaks, warped surfaces, scorched wires, popped rivets, and markings of improper maintenance or damage are noted. P & E's wipe film and dust from metal surfaces and with the aide of a strong light or magnifying glass, carefully search for growing cracks or corrosion. A P & E may also test suspicious surfaces with the tap of a coin, a stick of adhesive tape, or the drop of liquid penetrants. However, even the P & E is unable to detect or predict all major damage in an aircraft.

The most important skill of a person trained at diagnosing problems is knowing *where* to look for exterior signals of internal damage. Internal damage is the most insidious because it cannot be detected and corrected by the typical maintenance worker. However, when the P & E suspects internal damage, he can request industrial testing to verify his suspicion.

If all else fails, most P & E's have developed an intuitive sixth sense about the overall deterioration level of an aircraft. After years of estimating deterioration from exterior symptoms and comparing estimates to dismantled interiors, P & E's have become experts at deciding which aircraft need rework and which aircraft can afford to stay in the fleet longer. These evaluations are forwarded through the NARF management to NALC (Naval Air Logistics Command).

In 1972, Lewis Neri and Harold Law developed a quantitative "profile index" to help depot management decide which aircraft should be admitted to rework at Corpus Christi Army Depot [Ref. 1: p. 335]. In 1985, Dale McPherson at NARF Norfolk altered the Army's model to fit the specific problems of A-6 aircraft [Ref. 2: p. 1]. Until that time, NARF logisticians had relied primarily on the qualitative judgement of P & E's with the assistance of experienced aeronautical engineers as their decision basis.

B. THE PROBLEM

The key problem becomes evident when one attempts to segregate the combination of aircraft defects which perpetrated the P & E's recommendation. Using Neri and Law's original research and McPherson's lessons learned as a model, this study attempts to formulate a quantitative basis to evaluate P-3 aircraft for depot rework. In this study the reader may assume that a P-3 refers to all models and updates of the four-engined turboprop aircraft built by Lockheed-California Company for the purpose of antisubmarine and antisurface naval warfare.

C. SCOPE AND APPROACH

The scope of this thesis is limited to describing the P & E's job and the environment where he works. As a means of providing more consistent evaluations, more productive feedback, and a technical audit trail, a quantitative model simulating the P & E's decision criteria is provided in this study. Every decision that P & E's make while inspecting a P-3 will not be represented. However, the proposed model does include many of the more important decisions that P & E's make based on their view of how the aircraft being inspected compares in deterioration levels to those that P & E's have observed on other P-3's. The importance of one material discrepancy over another is reflected in the revised inspection form's implicit weights. However, this model does not include a single valued threshold which could serve as a criterion for management's decision to curtail a P-3's current OSP (Operational Service Period).

The approach used in this study follows Neri and Law's technique for cost effective depot level management. First, expert opinion was solicited from NARF P & E's. After discussing alternative models, the group at NARF Alameda agreed that the Army method most closely resembled the P-3 evaluation problem. Selection of leading indicators or critical inspection areas was next decided upon. Pairwise comparisons were used to rank leading indicators. Next the model of Neri and Law was used for

weighting inspection areas relative to their importance to the final evaluation. Their model is based on subdividing the area under an hyperbolic curve to provide the relative influence that a leading indicator contributed to the total problem. Finally, each leading indicator's weight was divided into levels of deterioration to reflect conditions that a P & E can differentiate while inspecting a P-3. The end result is an experimental ASPA evaluation form which is ready for testing and comparing with the results of the present ASPA evaluation form in Appendix B.

D. PREVIEW

Chapter II addresses the engineering basis of the P & E's decision from first procurement of the P-3 to contemporary considerations. Chapter III explains the economic realities of P-3 rework which complicate the P & E's decision. Chapter IV suggests quantitative approaches to modeling the P & E's decision process. Chapter V proposes a quantitative approach for the ASPA Evaluation. Chapter VI provides a summary, conclusions, and recommendations. Appendices display two examples of evaluation forms devised to record the P & E's impressions, to assist the P & E in making the appropriate overall decision, and to communicate this decision to safety engineers at the NARF.

II. PROCURING AIRCRAFT RELIABILITY AND MAINTAINABILITY

A. SYSTEM DEVELOPMENT

Operational availability estimates in naval planning documents played an important role in the decision to procure the P-3 from Lockheed-California Company. Operational availability is defined as the probability that a system or component is in an operable state at the start of a mission when called for at an unknown (random) point in time under stated conditions in an operational environment. Availability is a function of reliability, maintainability , and fleet support and is maximized by the balanced tradeoffs of these parameters during the design and development process. [Ref. 3: p. 65]

Reliability is defined as ". . . the probability that a system or device will perform without failure under given conditions for a specified period of time " [Ref. 4: p. 305].

> Maintainability, like reliability, is an inherent characteristic of system or product design. It pertains to the ease, accuracy, safety, and economy in the performance of maintenance actions. [Ref. 3: p. 15]

R & M (reliability and maintainability) are designed and built into a major weapon system by the manufacturer. The purpose of this chapter is to highlight the important role that R & M play in the acquisition process and their relationship to the logistics support of a major weapon system such as the P-3.

The acquisition process of a major weapon system is delineated in the Office of Management and Budget Circular A-109 and the 5000 series Department of Defense Directives. The "cradle to grave" policies in A-109 begin with the recognition of a mission need.

1. Concept Exploration Phase

When the mission need calls for a naval aviation concept, the Naval Air Systems Command appoints a PM (Program Manager) to produce a System Concept Paper. The Assistant Commander for Logistics and Fleet Support (AIR-04) works with the PM in recommending logistics requirements for the new system. Design proposals to satisfy these requirements are solicited from industrial contractors with specific qualifications and strengths in a desired technology. Alternative concepts from

competing responsive and responsible contractors are evaluated. Ideas from universities, federal contract research centers, or Navy Research and Development Laboratories are combined with historical operating and support data to provide a preliminary R & M evaluation of each contractor's concept alternative. The product of this Concept Exploration phase includes Milestone Review Documentation and a preferred concept which is submitted to the Joint Requirements and Management Board (JRMB) and the Logistics Review Board (LRB), among others, for review.

2. Demonstration and Validation Phase

If the Secretary of Defense approves the preferred concept alternative, the weapon system proceeds to the Demonstration and Validation phase. In this phase, the Program Office translates environmental operating conditions into contractual requirements so they can be included in design solicitations.

An Integrated Logistic Support Plan is developed by the contractor to conform to operating conditions. In this document the contractor identifies plans for implementing the system's maintenance and support concept. Goals for attaining acceptable R & M tradeoffs between the best technology support concept and available resources are decided. Also the new system's support funding profile is compared with similar recent programs.

3. Full Scale Development Phase

Once the Demonstration and Validation Milestone Review Documentation is approved, the program enters the Full Scale Development Phase. The Department of Defense Directive 5000.4 issued guidance in July of 1980 to establish a series of reliability goals and thresholds that the PM must enforce. This guidance recognizes that reliability of the weapon system is a basic function of the design and that post-design fixes are an inefficient method for achieving reliability goals.

Successful techniques used by many contractors in the Full Scale Development Phase to attain reliability goals are FMEA (failure mode effects analysis), apportionment of reliability requirements, parts control and standardization, design simplicity, redundancy, and increased safety margins. [Ref. 5: p. 4-59]. However, one of the best ways of improving the reliability of aircraft components involves cooperation between the aircraft designer, specialist engineers, and maintenance personnel who have had experience with the same or similar components.

> The design effort starts with searching for the best similar equipment already in service, scrutinizing operational experience regarding mean time between failures,

mean time between unscheduled removals, major failure modes, and potential improvements [Ref. 6: p. 24].

The Full Scale Development phase also includes more specific details about maintainability. Concern in this phase is with accessability, interchangeability of like components, standard parts, standard tools, corrosion control, handling ease, and built-in test equipment. An output of this phase is the Integrated Logistics Support Plan.

The Integrated Logistics Support Plan attempts to minimize logistics requirements throughout design by providing feedback during development. Logistics risks, the range and depth of logistics requirements, and supportability of the hardware are reviewed in the Logistics Support Analysis (LSA).

Several important documents are the output of LSA. One of the more important is the Maintenance Plan (MP). The MP includes level of repair analysis, reliability-centered maintenance analysis and failure mode effects analysis. RCM (Reliability Centered Maintenance) analysis is directed at a fairly small number of significant items - those whose failure might have safety or major economic consequences. These items are subjected to intensive study, first to classify them according to their failure consequences and then to determine whether there is some form of maintenance protection against these consequences. This process has been adopted by all major airlines and military services. Nowlan and Heap, in their book, *Reliability-Centered Maintenance* [Ref. 7], developed this process first for the airline industry. Since then it has been extended in the Navy to fleet aircraft and shipboard systems.

The Phased Support Plan is an offshoot of the MP and identifies maintenance support responsibilities during the transition of the aircraft from the vendor to the military owner. It includes responsibilities for all three levels of maintenance activities, i.e. organization, intermediate, and depot level. The MIR (Master Index of Repairables) is another by-product of the MP. The MIR lists all of a weapon systems repairable components and projects a five year workload to be accomplished on each component by all levels of maintenance.

Of course, the LSA is carefully integrated with performance parameters to assure compatibility while optimizing the whole weapon system. Military Standard 449A [Ref. 8] describes this weapon system engineering as the integration of performance, reliability, maintainability, safety, surviveability, and human factors into the total engineering effort.

When the Full Scale Development milestone review documentation is completed, final design reviews determine the adequacy of contractor and Navy efforts to achieve design objectives. Usually participants are qualified as design specialists in the areas of reliability, maintainability, safety, and logistic supportability and work for the Naval Air Development Center. The major reviews conducted during systems development include a preliminary design review, a critical design review, a design certification review, a functional and physical configuration audit, a first-article configuration inspection, and a pre-production reliability design review.

4. Production Phase

Financial and progress reviews by the JRMB and LRB plus approval by the Secretary of Defense are required before the program can continue into the final phase of the acquisition process known as Full Scale Production. The identification and correction of problems in product quality are critical during the production phase. The aerospace industry identifies problems by performing many quality assurance inspections after each manufacturing step.

B. PRODUCTION QUALITY

Airframe manufacturers use quality control inspections to correct problems associated with work hardening corrosion, stress corrosion, hydrogen embrittlement, and fracture mechanics. [Ref. 9: p. 5] At present sophisticated x-radiation, ultrasonics, eddy current, and fracture mechanics techniques are used as normal procedures during structural tests, both on complete airframes and on components.

1. Fracture Mechanics

The field of fracture mechanics is used extensively to evaluate material characteristics and to quantify quality assurance results along lines similar to those used as safety measures for space-vehicle pressure vessels. The F-15 procurement program used fracture-mechanics analysis during its initial production stage. The most expensive fracture-control plan to date is used in the B-1 bomber's quality assurance program. [Ref. 10: pp. 10-18]

> In order to insure this safety it has to be predicted how fast cracks will grow and how fast the residual strength will decrease: Making these predictions and developing prediction methods are the objects of fracture mechanics [Ref. 9: p. 7].

The presence of flaws too miniscule to be reliably detected in the manufactured material is assumed in fracture mechanics. A fracture-control inspection plan is intended to circumvent catastrophic failures from production or service-induced flaws that are usually not found by current quality assurance procedures.

Developing designs which have in-process quality controls like fracture mechanics are beneficial, but are cost prohibitive for lower performance aircraft like the P-3. Therefore, airframe quality may be degraded by changes in tooling, processing, and workflow. However, without utilizing fracture mechanics in updated versions of the P-3, future problems could occur. For example, designers are aware of the less desirable fracture characteristics of high strength materials, but they may choose them over a more fracture resistant material due to a requirement to attain specific aircraft performance such as fuel economy due to harder material's lighter weight. A flawless structure is more difficult to manufacture in harder materials that need more accurate machining and processing techniques. In addition, quality-assurance methods often are inadequate for reliable detection of the small flaw sizes that are significant in these lower tolerance materials. [Ref. 10: p. 14]

One of the most important, yet difficult elements of an effective fracture-control plan is the accurate estimation of an airframe's service life [Ref. 10: p. 39]. In particular, current procedures of P-3 service-life estimation produce only a partial characterization of service life due to limitations in a coherent database. Essentially, service-life for P-3's must be derived from theoretical reliability computations based on probability distributions.

2. Mathematical Predictions

Mathematical theories on the subject of reliability provide a choice for the probability distribution of component failures and assumptions for the independence of failures. Many relationships between failure rates and component life have been theorized for the purpose of modeling observed samples. A popular, easy to understand relationship which is often assumed is known as the bathtub curve. The bathtub curve as depicted in Figure 2.1 attempts to describe the mean failure rate of a component over its lifetime. During the early life, a high rate is assumed. This rate drops off rapidly, however, and there is a long period having a constant failure rate. Finally, a rise in the rate is expected as the component "wears out". The exponential probability distribution is typically associated with the flat part of the bathtub curve. A Normal or Weibull distribution may better fit a more complex component or structure.

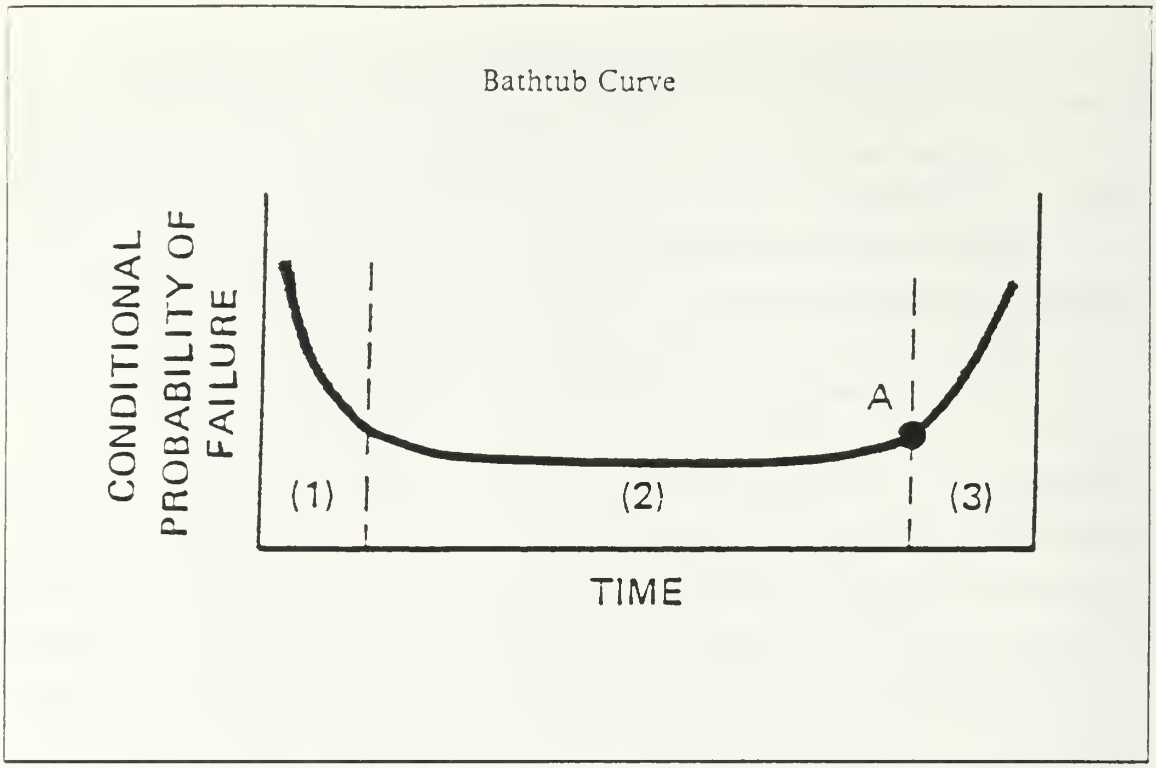

Figure 2.1 Failure Rate versus Age of Components.

The service life estimation of exposed structures on a P-3 is complicated by the variety of environments encountered by P-3's. The long distances travelled on each mission, the variety of landing locations it operates from overseas, and the isolated application of doubler patches to repair individual airframe damage reduces crack prediction accuracy. For instance, when computing crack propagation on a P-3's fuselage, unpredictable environmental factors such as temperature and the presence of humidity, water, fuels, or other chemicals must be considered, in addition to determining the load on sections of an individual fuselage. MILSTD 781C [Ref. 11] recommends that the exponential distribution be used for most reliability design qualification and production acceptance tests including those for the P-3.

3. **Aircraft Acceptance**

Military Standard 781C [Ref. 11] has set levels which it uses for production acceptance testing. These acceptance tests attempt to insure that the manufacturer achieves the reliability goals specified in the production contract. However, like pre-production qualification tests and initial operational test and evaluation, production

acceptance tests should be conducted by government or contract personnel who are independent of the producing contractor. This is an added measure to account for conflicting interests and to insure that the Navy gets what it contracted for.

The Program Manager must realize that the contractor is obligated to his shareholders to develop a piece of equipment at the least expense and at the lowest acceptable reliability. Under fixed price acquisitions the contractor must reduce costs to increase his profit. Reliability can become a tradeoff victim if it is not clearly monitored. The PM must not forget the contractor's interest in the support of the system being produced because "The contractor also has an eye on the downstream spare parts market, which a production system represents. Any increases in reliability would actually be counter productive to participation in this future market." [Ref. 12: p. 9] Only the contractor's reputation is at risk if the operational failure rate is substantially lower than the theoretical. To transfer more risk to the contractor and nurture reliability growth, product warranties may be necessary in the early phases of development. Warranties typically provide the Navy protection against manufacturing or design defects for a specified period of time. Warranted fixes are repaired at cost to the Navy.

4. Product Improvement

Any new component has the possibility of unanticipated failure. However, serious unanticipated failures should motivate some sort of product improvement. MILSTD 2173 specifies that the logic diagram in Figure 2.2 be used to justify suspected product improvements [Ref. 11: p. 96]. Problem components are redesigned at great expense. Once designed and tested, the operating fleet is then modified as quickly as possible with the design fix. "Product Improvement, based on identification of the actual reliability characteristics of each item through age exploration, is part of the normal development cycle of all complex equipment" [Ref. 7: p. XX]. The design and maintenance organizations should work together to diagnose the failed mechanism, because this information is necessary for product improvement.

Information necessary to substantiate Product Improvement is found in the Navy's Maintenance and Material Management (3-M) system's Maintenance Data Collection System (MDCS). The MDCS data base is also useful for computing equipment reliability, maintainability, and availability factors. [Ref. 13: p. 2].

In 1967 the Navy established a P-3C Weapon System reliability goal of ninety percent probability of success. Success is defined as starting with a Fully Mission

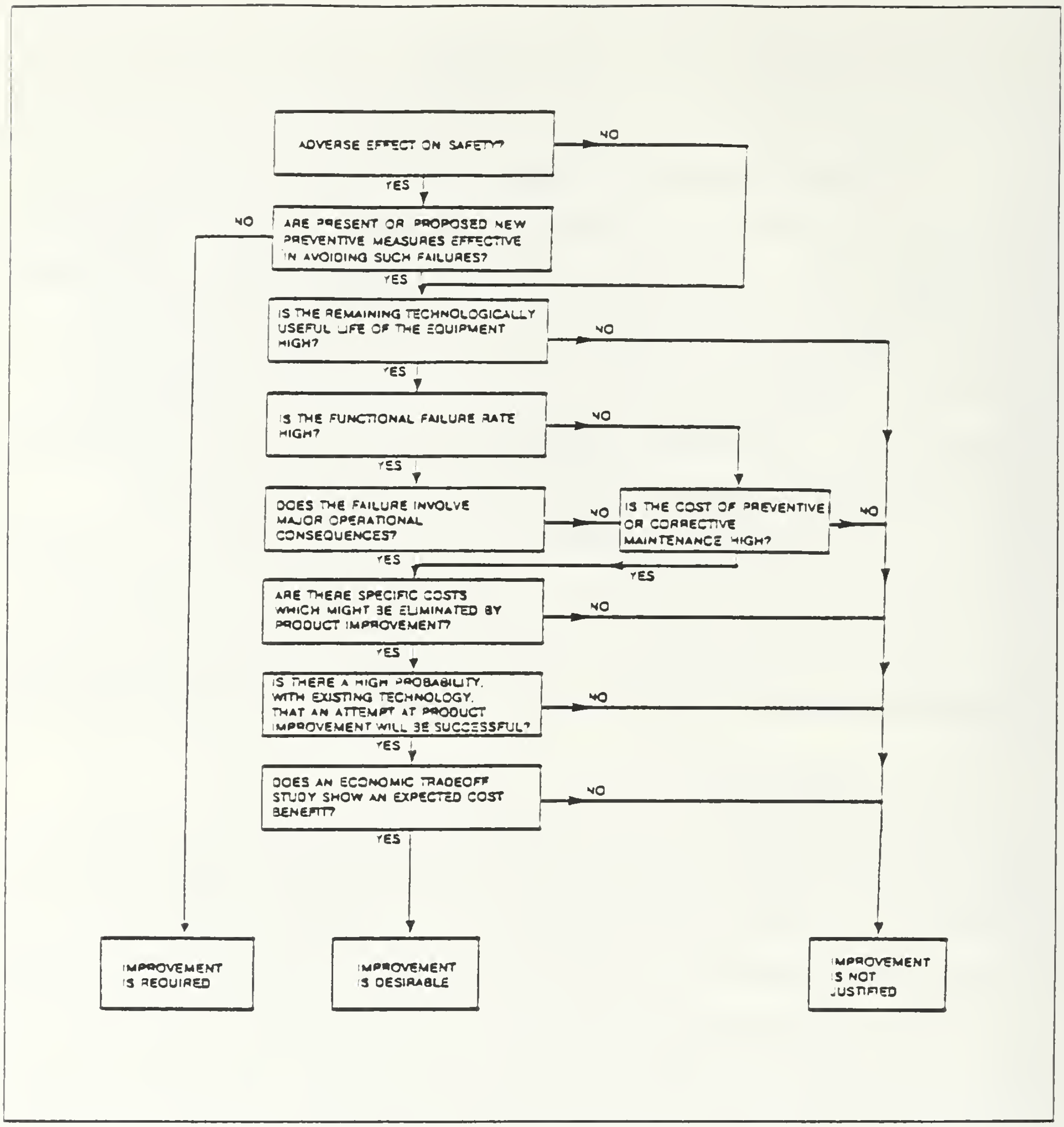

Figure 2.2 Logic Diagram for Product Improvement Justification.

Capable aircraft and completing a normal twelve-hour antisubmarine warfare mission operating all weapon sensors. Therefore, a continuous comparison of actual versus required reliability was necessary throughout the program. Lockheed management's reliability control areas included reliability analysis, design surveillance and review, test planning and monitoring, supplier reliability controls, failure analysis and corrective action, data processing, reliability demonstration, reliability measurement, and

reporting of reliability program status. Lockheed also prepared a reliability study for the P-3C weapon system as a result of the increase to a 90% mission goal. Subsystem design concepts were subsequently changed to improve any reliabilities which were below this goal. [Ref. 13: p. 4]

"In most cases, the greater the reliability achieved the greater the development and acquisition cost and the less the maintenance and support cost." [Ref. 14: p. 3] This Life Cycle Cost approach may explain the P-3 Program Manager's rationale for insisting on reliability growth in the P-3 Reliability Engineering Program Plan. Maintenance factors such as modularization, accessibility, and fault-isolation were also intended to lower life cycle costs. While reliability in many subsystems did improve, the acquisition cost increased by several million dollars. This cost tradeoff is contested even today by Secretary of the Navy, John Lehman.

C. CONCLUSION

In conclusion, the problem of R & M is predicting which aircraft parts are most susceptible to failure and how and when they can be expected to fail.

> The complexity of modern equipment makes it impossible to predict with any degree of accuracy when each part or each assembly is likely to fail. For this reason it is generally more productive to focus on those reliability characteristics that can be determined from the available information than to attempt to estimate failure behavior that will not be known until the equipment enters service. [Ref. 7: p. 141]

III. DEPOT LEVEL MAINTENANCE

A. INTRODUCTION

The primary objective of RCM (Reliability Centered Maintenance) is to ". . . maintain, at minimum cost, the operating reliability and safety levels that were originally designed into the equipment " [Ref. 15: p. 26]. The use of RCM analysis in the procurement cycle affects the way that depot level maintenance is performed and scheduled once an aircraft is deployed. By utilizing the wisdom of RCM and its emphasis on NDI (non-destructive inspection), it is possible to adjust an aircraft's service period to an optimal balance of safety and economy. However, before attempting to estimate the optimal service cycle of the P-3 aircraft, we should understand the activities of a rework facility, the Navy's application of RCM, the practical application of NDI, and the economic constraints involved.

B. NARF ACTIVITIES

According to the Chief of Naval Operation's Instruction (OPNAVINST) 4790.2C [Ref. 16: p. 3-1], the depot level of maintenance ensures the flying integrity of airframes and associated systems during subsequent operational service periods. Depot level maintenance refers to major rework or rebuilding of components or assemblies performed at a NARF. Depot level maintenance may also include manufacturing, modifying, testing, or reclaiming salvageable parts. This upper level of maintenance supports organizational level maintenance by providing sophisticated technical and engineering assistance, calibration, age exploration, and SDLM (Standard Depot Level Maintenance) when needed. However, the primary job of the NARF is SDLM.

The requirements for SDLM as mandated in OPNAVINST 4790.2C [Ref. 16: p. 10-2] are:

> . . . based on systematic engineering analysis of airframe, system and component design, operational performance, and reliability and maintainability data. The effectiveness of SDLM requirements is monitored and evaluated on a continuous basis through the use of supporting statistical and engineering analysis programs. The Analytical Maintenance Program (AMP) is the primary authority for the technical validity of SDLM.

In OPNAVINST 3110.11Q [Ref. 17: p. E-7], a SDLM is defined as ". . . rework performed at a military rework facility or commercial contractor's facility at specific intervals during the service life of an aircraft." The intervals are determined by engineering analysis and are based on operating service months and flight hour accumulation. If no adjustments are required, the newest P-3C aircraft is required to receive SDLM every sixty months. By the time the third SDLM is performed, the service interval is shortened to fifty months. Four additional SDLM's are required at forty month intervals until the total operational service life is achieved. This is 330 months according to current CNO guidance.

The scope of SDLM to be performed at a NARF is controlled by specifications which are published by the CFA (Cognizant Field Activity). For the P-3, the CFA is NARF Alameda. However, the CFA does not have the authority to remove or alter the operating restrictions or specified service life limitations. This authority remains with the Commander of the Naval Air Systems Command as explained in NAVAIR Instruction 5400.14C [Ref. 18: p. 3].

The Naval Aviation Logistics Command manages the scheduling of aircraft starting SDLM. Once an aircraft starts SDLM, a comprehensive E & E (examination and evaluation) checks the operation of an aircraft's systems. Afterward, the fuel and oxygen systems are drained and the engine and fuel cells are preserved. The second stage of E & E documents discrepancies with regard to airframe condition and integrity. Many component parts such as engines and avionics are removed and reworked separately. [Ref. 19: p. 18]

The third stage of SDLM involves stripping paint from the airframe 's exposed surfaces to check for corrosion. The corrosion found is subsequently eliminated and the airframe is treated with corrosion resistant chemicals. A plant E & E (Estimator & Evaluator) inspects for hidden corrosion, cracks, or unusual wear. "Where necessary for further inspection, rivets are removed and the skin peeled back" [Ref. 20: p. 27].

The fourth stage of SDLM consists of metal repair, structural modification, and change kit installation. Component parts are replaced and checked for proper operation. The airframe is then painted with primer. Application of the final coat of paint completes the fourth stage. [Ref. 19: p. 18]

The final stage of SDLM requires the aircraft to be weighed and balanced with dry fuel tanks. After weighing the aircraft, the landing gear is drop-checked, the fuel cells are filled and checked for leaks, and the engines are tuned up. The aircraft is

ready for its functional-check flight after all systems become operational on the ground. Check flight discrepancies are repaired following the flight. If the aircraft passes the final inspection, it is ready for issue to the fleet. [Ref. 19: p. 18]

C. ANALYTICAL MAINTENANCE PROGRAM

1. Background

The Analytical Maintenance Program was adopted by the Navy in 1974. The trial phase of this program was evaluated in Patrol Squadron 40 based at Naval Air Station Moffett Field, California in August 1973. Lockheed-California Company was contracted to tailor United Airlines' proven RCM logic to the P-3's low-level patrol mission and harsh operating environment. The Lockheed analysis group led by Frank H. Connell applied the L-1011 TriStar Maintenance Program to all forty-five P-3 squadrons by March 1975. The Depot Level Maintenance Program was completed at NARF Alameda in July 1975. [Ref. 21: p. 12]

2. RCM Logic

Lockheed's analysis group selected SSI's (structurally significant items) on the P-3 and developed the military's first structural sampling inspection program. Each of the SSI's was determined ". . . based on logical step-by-step, 'yes/no' decision "diagrams" which consider the effect on the aircraft if the part should fail " [Ref. 22: p. 11]. The first two questions in Figure 3.1 [Ref. 21: p.13], address the relative effect of flight safety if a component fails. The last two questions consider the effect of failure on operational performance and economics. These questions are designed so that vital elements are not disregarded and items are treated equally. From the 81 systems on the P-3, the team determined that 406 items were structurally significant [Ref. 21: p. 12].

The result of the RCM logic process is the separation of SSI's into three defined categories:

- *Hard Time Limit* - An item which demonstrates a predictable reliability relationship between age and degradation. At a conservative age, these items are replaced.
- *On Condition* - An item which requires a scheduled inspection or test to determine degradation and impending failure.
- *Condition Monitoring* - An item requiring no scheduled inspections because it can be checked visually, monitored by instruments, or surveyed from data. [Ref. 23: p. 13]

By separating the SSI's into these categories, several former assumptions about maintenance inspections are refuted. One long held assumption is that

1. Is there a "Condition After Failure" that has a direct, adverse effect on operating safety?

NO ↓ ; YES ⟶ Requires a scheduled maintenance action, or design change if no action can be identified.

2. Is there a function hidden from the flight crew that has a potential adverse effect on operating safety?

NO ↓ ; YES ⟶ Requires a scheduled maintenance action, usually an operational check.

3.Is a reduction in resistance to failure detectable by in-place maintenance or unit test?

NO ↓ ; YES ⟶ Requires a scheduled maintenance action, usually a periodic inspection.

4. Is there a demonstrated adverse relationship between age and reliability?

NO ↓ ; YES ⟶ Requires a scheduled maintenance action, usually fixed-frequency replacement.

No scheduled task is required.

Figure 3.1 Decision Tree Logic Diagram: The Basis of P-3 Maintenance.

increasing maintenance reduces failures. A U. S. Air Force analysis demonstrated that 40% of the work required to return a statistically significant sample of F-4's to operational status was directly attributed to failures caused by previous maintenance [Ref. 23: p. 14]. A Navy study concluded ". . . that an aircraft will be statistically less reliable and will require more unscheduled lower level maintenance after depot maintenance than before" [Ref. 20: p. F-4].

A second assumption was that all of an aircraft's parts need to be overhauled or they will fail with age. However,

> An analysis of hundreds of aircraft components by commercial airlines and (other) aircraft reveals that all go through a burn-in stage and a stage of low probability of failure over some period of operation. Very few components reach the wearout stage in their normal operating lives. . . . (For example,) United Airlines intensively studied 140 aircraft components from all aircraft types in their fleet. Ninety-four percent were found to have no need for a scheduled time limit for the accomplishment of maintenance actions. Corroboration of this is seen in the statistics developed by Lockheed on the S-3 (aircraft). [Ref. 20: p. 43]

3. P-3 Experience

The success of the Analytical Maintenance Program prompted the CNO to incorporate the RCM philosophy in all front-line aircraft starting in 1973. [Ref. 24: p. 18] By revising the maintenance program to include RCM logic, Patrol Squadron 40's maintenance department reduced the on-condition maintenance tasks from 90.5% of all maintenance tasks to 46.8% and reduced the hard time replacements from 9.5% of all maintenance tasks to 6.5% [Ref. 21: p. 16]. The use of RCM procedures saved the NARF at Alameda 2,000 man-hours per P-3, totalling $3.41 million in fiscal year 1976. More importantly the RCM procedures almost doubled the availability of new P-3's by extending the average depot rework interval from 34 to 60 months.

D. AIRCRAFT EVALUATION

Even though the Navy has accepted RCM logic as a basis for its Analytical Maintenance Program, the problem of evaluating aircraft requiring SDLM still needs resolution. Clearly, identification of structurally significant items or zones is a vital prerequisite to airframe inspections. However, such items tend to be difficult to identify since:

> The generic term SSI (structurally significant item) is used to denote each specific structural region that requires scheduled maintenance to guard against the fracture of a significant member. This region may be defined as a site that includes a number of structural elements, . . . the significant member itself, or . .

. . . a particular region on the member that is the best indicator of its condition. [Ref. 7: p. 84]

Most of an airframe is evaluated by on-condition inspections of the regions identified as best or leading indicators of a member's condition. However, the primary intent of these inspections is to find and repair corrosion, fatigue, and accidental damage as early as possible to preclude the expensive and arduous task of replacing failed structural members. [Ref. 7: p. 84]

E. INSPECTIONS

1. Inspection Policy

The frequency of inspecting specific zones at the depot is outlined in the *Analytical Maintenance Program Standard Depot Level Maintenance Specification: Navy Model P-3 and Derivative Series Aircraft* (31 March 1986) published by direction of the Commander, Naval Air Systems Command. This specification contains requirements to inspect certain zones 100% of the time and other zones on 20% of the sample aircraft. Many inspection tasks are required on Lead-the-Fleet aircraft as well as aircraft which have exceeded 75% of the Fatigue Life Index.[1] Some tasks are accomplished when the opportunity arises such as the removal of a damaged fuel bladder, which allows an inspector access to internal wing planks.

2. Opportunity Inspection

Another form of opportunity inspection occurs when corrosion is detected. When corrosion is found or suspected and the extent is undetermined ". . . the adjacent structure shall be disassembled, i.e., the skin shall be peeled back, fittings . . . removed to the extent required " [Ref. 25: p. 2-6].

Inspections by highly skilled personnel often result in further opportunity inspections during the initial disassembly process when a P-3 enters SDLM. E & E (Examiner & Evaluator) personnel note

> . . . cracks, corrosion, damaged controls, worn hinges, attach fittings, bearings, bushings and bolts, distortion and elongation of bolt holes, and any signs that may lead to disassembly to a greater depth . . . [Ref. 25: p. 2-34].

---

[1]The Fatigue Life Index is a product of statistical analysis of accelerometer readings which indicate the structural fatigue consumption of an aircraft. Naval Air Development Center Report 13920-1 disseminates an estimate for each aircraft quarterly to cognizant NARF's.

The E & E will also inspect zones specifically requested by the delivery activity, intrinsically determined from the aircraft's service record, or historically deteriorated from past experience.

3. Non-Destructive Inspection

If the E & E suspects deterioration, NDI (non-destructive inspection) methods are often required to verify material condition. The NDI methods used most often are eddy current, fluorescent penetrant, magnetic particle, radiographic, and ultrasonic in accordance with MIL-STD-271 [Ref. 25: p. 2-10]. Determination of the best method to use is based on accessibility to structural surfaces and the availability of appropriate tools.

Eddy current NDI is used for finding inclusions and cracks near the surface of electrically conducting structural members. For example, SSI's on the P-3 requiring eddy current NDI are the upper engine nacelle attach plates and the centroid riser cavity radii in the wing [Ref. 25: p. 2-53].

Fluorescent penetrant is the most commonly recommended NDI method in the NAVAIR P-3 SDLM Specification. The universal application of fluorescent penetrant to clean nonabsorbent material is limited only by accessibility. Surface cracks on forged or machined SSI's such as the problematic forward spar cap attachment fittings and the nose landing gear steering housing are found using fluorescent penetrants.

Magnetic particle NDI is used to highlight surface and subsurface flaws. Ferrous materials can be inspected by first magnetizing them. SSI's like the dorsal fin angle attachment clips or the engine nacelle's longeron attachment's specified in the NAVAIR P-3 SDLM Specification are inspected using magnetic particles.

Application of x-ray NDI is widely used and respected for detecting interior distortions, cracks, and clearances between parts. This method of NDI is used to inspect welds for cracks on the P-3's oil cooler augmenter as well as other areas. X-rays can also verify the presence of corrosion. [Ref. 25: p. 2-65]

Ultrasonic NDI is another means of detecting interior flaws. A highly trained inspector can ultrasonically detect a crack deep within the P-3's nose landing steering collar or a horizontal stabilizer skin plank [Ref. 25: p. 2-58]. Ultrasonics can also be used to measure the degree of corrosion present on aircraft surfaces.

F. ECONOMICS

NDI is certainly helpful as an additional inspection, but depot management must balance the total cost of inspection and ultimately the total cost of SDLM against the potential cost of failure of an aircraft in flight [Ref. 26: p. 18].

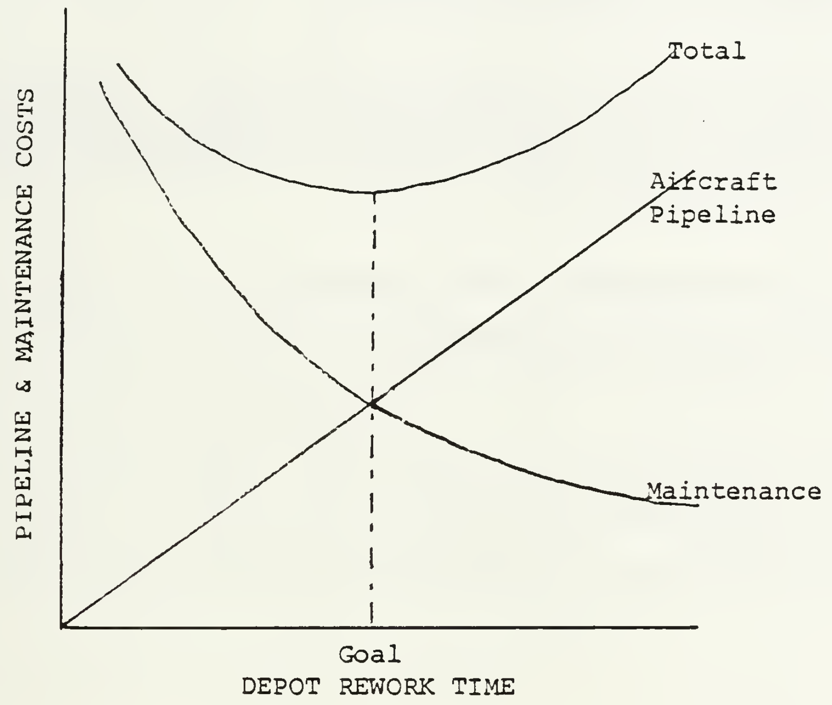

Figure 3.2 Cost Tradeoffs for Aircraft Availability.

The key to these costs is material condition. One might further hypothesize that material condition permitting, a P-3 can remain in operational service until inspections indicate there is an economic need to induct the aircraft into SDLM. The hypothesized relationship between SDLM costs and the lack of aircraft availability due to SDLM (pipeline) costs is illustrated in Figure 3.2 .

The Navy's ASPA (Aircraft Service Period Adjustment) Program attempts to minimize the P-3's total cost (Life Cycle Cost) while maximizing the number of aircraft available for operations in the fleet. The ultimate goal of the ASPA program is to seek the lowest point on the total cost curve in Figure 3.2 which corresponds to the most cost effective mix of pipeline aircraft and SDLM resources. Hitch and McKean in their book, *The Economics of Defense in the Nuclear Age*, summarized proposals similar to the economic goals of ASPA when they wrote,

> Military choice can be a very subtle and complex matter . . . No simple formal model of choice is likely to be sufficient for a satisfactory analysis of most real military problems. But it is often enlightening to formulate parts of the problem of choice in economic terms, that is, in terms of discovering the most effective uses of limited resources. [Ref. 27: p. 361]

The relationship between the ASPA program and SDLM resources is not clear due to the complex nature of scheduling aircraft for SDLM, production control, component availability, non-SDLM rework, contractor dependability, labor shortages, and funding constraints at the NARF. An example of how difficult it is to maximize the economic capacity of a NARF occurred in 1973. Logistics Management Institute ended its year-long study by recommending that further studies on NARF economies of scale be discontinued due to unpredictable economic factors. [Ref. 28: pp. 27-29]

IV. QUANTITATIVE APPROACHES

A. ASPA(AIRCRAFT SERVICE PERIOD ADJUSTMENT)

OPNAV Instruction 3110.11Q [Ref. 17: p. E-6] states that aircraft in the ASPA program (which includes most fleet aircraft) will remain within the manufacturer's recommended flight hour and structural fatigue life limitations. This authorized operating service life is divided into varying length's of OSP's (operational service periods) based on the accumulated flight hours, operating service months in the fleet, or operating months per flight hours. Aircraft which "pass" the ASPA program's required inspection will have their OSP end date extended for twelve months. Aircraft which "fail" ASPA and are not inducted into SDLM within 90 days of their OSP end date will be flown to the NARF and grounded. The controlling custodian may make exceptions on a case by case basis, but generally the ASPA inspection results determine what year a specific P-3 will enter SDLM.

P-3 Local Engineering Specification GEN/AL 12-9-0110 found in Appendix A of this thesis, contains an ASPA Inspection Results Form which lists 109 inspection tasks. This list is an attempt to assist the P & E and the CFA who evaluate whether a particular P-3 is deteriorated enough to receive the most economical SDLM possible. However, when inspection forms are reviewed and NARF management attempts to reproduce the P & E's decision logic for passing one aircraft and failing another, the inspection forms may become inadequate. The same is true when one tries to rank P-3's and other naval aircraft by material condition. The outcome is ambiguous and highly subjective. [Ref. 29: p. 39]

CFA engineers and P & E's interviewed by Dale McPherson, A-6 Air Vehicle Engineering Branch Head at NARF Norfolk, agreed that a quantitative method of evaluating aircraft inspected for ASPA might be both desirable and possible. Further, a quantitative method would presumably give the CFA a workable index to control an entire community of aircraft such as the P-3. However, all personnel interviewed were concerned that a quantitative inspection form which was biased toward economics might slight the importance of critical safety defects. For this reason, an ASPA evaluation based on estimated man-hours to repair all defects was not endorsed. [Ref. 29: p. 40]

On the other hand, qualitative judgements by the P & E can never totally be disregarded. Therefore, an ASPA evaluation which includes both quantitative and qualitative criteria could provide the CFA with a profile index to rank prospective candidates for SDLM while retaining the necessary subjective opinion of an experienced P & E. This author chose to model the P-3 ASPA evaluation in Chapter V after the experimental A-6 ASPA evaluation in Appendix B.

B. A REVIEW OF ANALYSIS METHODS

Several methods have been devised for quantifying subjective judgements under conditions of uncertainty. A brief review of their procedures, advantages, and disadvantages is helpful to justify selecting the most appropriate method.

1. Delphi Technique

The Delphi Technique is a method of statistically refining the opinions of a group of experts or especially knowledgeable personnel. The advantages of group judgement in long range planning as well as the disadvantages of "group-think" are clearly summarized in Stoner's text, *Management*. [Ref. 30: p. 344] The poorly conceived notion to conduct the Bay of Pigs invasion is considered to be a prime example of group-think. Group-think, resulting in premature agreements or mediocre compromises is a major drawback to the group decision process as is the influence of a dominant individual (one who does the most talking). Another disadvantage to group decisions is the irrelevant or misinformation that clouds the pertinent material presented during discussions. A final major drawback to group decision-making is the group's pressure to compromise.

As a means of lessening the disadvantages of group interaction, the Delphi Technique was embodied with three integral elements by Norman Dalkey of the Rand Corporation:

- Anonymity
- Controlled feedback
- Statistical "group response".

Anonymity counters the effect that a dominant individual has on a group. Anonymity is preserved by using written questionnaires. Controlled feedback reduces the influence of misinformation on the group decision. Controlled summaries of questionnaires are returned to the group members over several iterations for their input. These summaries are controlled by statistically determining the median responses and the

range of responses. Successive response summaries require reappraisals of a respondent's previous conclusions as well as justifications for any marked deviation from commonly held group conclusions. [Ref. 31: pp. 25-27]

Although systematic processing of expert opinion used in the Delphi Technique appears to converge on reliable estimates for answers to qualitative problems, the technique's procedures are often criticized as cumbersome. Researchers also cannot determine the extent of the influence of factors such as social pressure, "rethinking" a problem, or idea transfer during feedback. Another disadvantage of the Delphi Technique is the misconception that conclusions from this process will be used in a pre-existing model. Often, a model has never been created for qualitative problems where the Delphi Technique has been found to be appropriate. [Ref. 31: pp. 27-29]

2. Analytical Hierarchy Process

A second method for quantifying the results of qualitative decisions is known as the AHP (Analytical Hierarchy Process). This process, devised by Thomas L. Saaty, addresses less of the sociological influences on the decision making process than the Delphi Technique does. AHP concentrates more on the structure of the decision making process. AHP identifies decision criteria, measures the interaction between the criteria, and synthesizes the resulting information to identify priorities. Priorities can be used to rank alternatives or to plan resource allocations in a non-market environment such as a NARF.

> Basically the AHP is a method of breaking down a complex, unstructured situation into its component parts; arranging these parts, or variables, into a hierarchic order; assigning numerical values to subjective judgements on the relative importance of each variable; and synthesizing the judgements to determine which variables have the highest priority and should be acted upon to influence the outcome of the situation [Ref. 32: p. 5].

a. Hierarchy

For example, consider the complex situation which an ASPA inspection team faces when it attempts to decide whether or not a P-3 requires SDLM. Through experience with typical or leading indicators of economic or safety related structural deterioration, a P & E team can draw a hierarchical sketch of their decision process. The hierarchy can be taken from structurally significant inspection zones listed on a P & E's Local Engineering Inspection Sheet. The P & E's logic, intuition, and experience

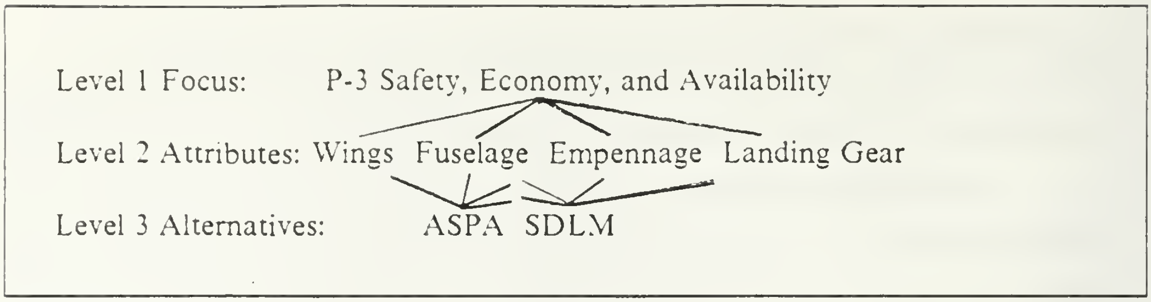

Figure 4.1 ASPA Inspection Hierarchy.

allows them to answer the question: How much more does one zone contribute than another to the overall need for SDLM? The AHP enables a P & E team to eventually compare all zones to obtain a weighted outcome. This method ensures that zones are grouped logically and ranked consistently to produce a flexible model of the P & E's judgement. Figure 4.1 illustrates a simplified hierarchy of the P & E's judgement process.

b. Matrix

The scale used within each AHP matrix ranges from 1 which denotes equal importance of the two elements compared, through 9 which represents absolute importance of one element over another. This Pairwise Comparison Scale, developed by Saaty and found in Table 1 , assumes that a scale of nine units " . . . reflects the degree to which we can discriminate the intensity of relationships between elements" [Ref. 32: pp. 77-78].

The P & E team needs to establish a priority for the attributes in Level 2. This is done by pairwise comparisons in a matrix form. The matrix presented in Table 2 provides:

> . . . a framework for testing consistency, obtaining additional information through making comparisons, and analyzing the sensitivity of overall priorities to changes in judgement [Ref. 32: p. 76].

By judging the element in the left-hand column as it relates to the element in the top row, the scalar values fill the matrix as seen in Table 2 . If the element in the left-hand column compares less favorably, then a fraction is noted in the matrix. A fraction is the reciprocal value of a judgement when the elements' roles are reversed later on in the comparison process. This provides for consistency when priorities are calculated.

TABLE 1

SAATY'S PAIRWISE COMPARISON SCALE

Intensity of Importance	Definition	Explanation
1	Equal importance of both elements	Two elements contribute equally to the property
3	Weak importance of one element over another	Experience and judgment slightly favor one element over another
5	Essential or strong importance of one element over another	Experience and judgment strongly favor one element over another
7	Demonstrated importance of one element over another	An element is strongly favored and its dominance is demonstrated in practice
9	Absolute importance of one element over another	The evidence favoring one element over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between two adjacent judgments	Compromise is needed between two judgments
Reciprocals	If activity *i* has one of the preceding numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	

The next step is to develop a quantitative weighting or priority ranking scheme. When calculating the priorities of a matrix objective, Saaty recommends that: (1) column values be summed and (2) each value be divided by its respective column total. The resulting values, called eigenvalues, can be used to calculate the hierarchy's weighting criteria. However, these values must first be checked for the consistency of the expert's judgements.

TABLE 2

PAIRWISE COMPARISON MATRIX OF P-3 ATTRIBUTES

Attributes:	Wings	Fuselage	L. G.	Empennage	Eigenvalue
Wings	1	3	7	9	57%
Fuselage	1/3	1	6	7	30%
Landing Gear	1/7	1/6	1	3	9%
Empennage	1/9	1/7	1/3	1	4%

Consistency Ratio = .067

c. Results

Judgement consistency is measured by means of a Consistency Ratio. this ratio is the result of comparing the consistency of random judgements on the same scale and the same size matrix. Judgements may be considered random if this value exceeds .10 and should probably be revised.

If the matrix represents consistent judgement, then, as mentioned above, the eigenvalue may be used to weight the problem's elements or attributes. In the case of choosing an alternative between ASPA and SDLM, the eigenvalue weights would prioritize the aircraft's zones in terms of percentages of importance. These zones are referred to as SDLM drivers. Knowing the "importance percentages" of SDLM drivers contributing to material condition is an important advantage when establishing a numerical threshold for the ASPA decision.

d. Pros and Cons

There are several other advantages to adopting the AHP which include [Ref. 32: p. 23]:

- *Unity* - AHP's one model is flexible enough to cover a wide range of problems.
- *Complexity* - deductive and systems approaches are integrated to solve complex problems.
- *Interdependence* - allows for nonlinear logic between problem elements.
- *Hierarchic structuring* - organize complex elements into simpler complementary levels.
- *Measurement* - new method developed to measure abstract attributes or alternatives.
- *Consistency* - assures harmony in repetitive judgemental logic.

The primary disadvantages to the AHP include:

- *Simplicity* - level analysis may identify too broad or too narrow a hierarchy to reflect the decision process.
- *Iterative* - calculating fluctuating eigenvalues on large matrices are time consuming even with computer assistance.
- *Confidence* - confidence interval estimation and hypothesis testing are not compatible with AHP's unfamiliar statistical model.
- *Consensus* - potentially difficult to resolve differences of expert opinion.
- *Commitment* - selling and coordinating the AHP to unwilling participants can cause questionable, untimely results.

3. Multi-attribute Utility Theory

Multi-attribute utility theory is one of the most popular methods for selecting a better solution to a problem when inputs are subjective. The developers of this theory, Von Neuman and Morgenstern, postulated that each person has a measurable preference among choices available in risky situations. They called this preference "utility" and measured it in units which they termed "utiles". Each person is hypothesized to maximize their expected utility when making a decision. [Ref. 33: p. 89]

In multi-attribute utility theory an expected monetary value or opportunity cost for each of a problem's alternatives is calculated. The results are derived from a person's preferences for particular outcomes and the probabilities that the problem's alternatives lead to those outcomes. These probabilities are based on the subjective predictions of the decision maker. The alternative with the highest monetary value or least opportunity cost is picked as the best alternative. [Ref. 34: p. 5]

Multi-attribute utility theory has been applied successfully as a decision making framework for military and industrial problems. [Ref. 35] While the theoretical value of the utility concept is useful in many problems, constructing scales of measurement for subjective data is no simple task. Much of the literature on subjective scales deals with pairwise comparison data. For instance, a market researcher may use this method to quantify the relative taste appeal of new food products.

> In the simplest paired comparison experiment, each of several judges examines a number of objects two at a time and states which of the two objects is preferred. No indication of strength of preference is given. Data from these paired comparisons are then used in a statistical model to estimate a scale or preference for the objects. [Ref. 34: p. 6]

a. Advantages and Disadvantages

The advantage of multi-attribute utility theory is the handling of tradeoffs in the decision making process. Typically decision makers will choose different alternatives when different attributes are considered. One alternative is seldom optimal for all attributes considered, so lower values on some attributes are acceptable as tradeoffs to obtain higher values in other attributes. [Ref. 36: p. 123]

The biggest disadvantage of utility theory is the assignment of utiles in place of expected values of objects such as money. For example, participants in the decision making process may assess the utility of money differently. Participants may change their values over time. Worker's values may also change depending on the level that they work in the organization. [Ref. 33: p. 97]

C. POINT SYSTEM

A common variation of utility based decision making is the point system. Mortgage companies prefer the point system when qualifying customers for loan eligibility. Universities have also been known to base admission decisions on subjective aspects converted to some number of points. For example, to qualify for admission, the admissions office may multiply an applicant's previous grade point average times a factor such as 100 and add the product to the applicant's entrance exam score such as the Graduate Management Admissions Test (GMAT) [Ref. 33: p. 100]. Needless to say, the point system simplifies the problem of student admissions and it costs the university less time and money than did previous more complicated, time intensive procedures. Cost effective operations is the key to managing any large organization, whether it is a university or a NARF.

V. A PROPOSED P-3 QUANTITATIVE APPROACH

A. COST EFFECTIVE DEPOT LEVEL REPAIR STUDIES

In 1972, Lewis Neri and Harold Law developed a quantitative "profile index" to help them decide which helicopters should be admitted for rework at the Corpus Christi Army Depot. Their primary objective was to cut costs due to excessive inspection man-hours and inefficient aircraft selection for depot rework. Neri and Law's point system simplified the reliability and maintainability goals by inspecting only critical safety items and "leading indicators".

1. Prioritizing Leading Indicators

Leading indicators, as defined by proposed NALCINST 4730.3A [Ref. 37: p. 14], are conditions related to areas, zones, and items that indicate the degradation in general material condition to such a level that it is obvious that depot level SDLM tasks would conserve the useful life and economic investment in the aircraft. Army Depot engineers compiled a list of leading indicators which field inspectors had used to determine which helicopters were in need of depot rework. This list of leading indicators which is sometimes referred to as inspection items in this study was then ranked by depot personnel experienced on the particular airframe:

> Initially the entire airframe was considered section by section and specific areas of deterioration identified. Then the impact of not repairing an area of deterioration was evaluated. [Ref. 1: p. 336]

Assuming that an aircraft is extended in the field without depot level rework, Army engineers ranked leading indicators based on four criteria:

- Aircraft safety
- Operational availability
- Economic effects of accelerated deterioration
- Economic effects of general wear and tear.

A subjective technique called the Emphasis Curve assisted these personnel in ranking a list of helicopter leading indicators through a pair-wise comparison using the four criteria. Figure 5.1 illustrates the Emphasis Curve technique using P-3 leading indicators. There are $n(n-1) / 2$ comparisons for n leading indicators.

Indicator Area Number:

15. Nose Wheelwell

18. Fuel Bay/Cell

2. Cockpit

20. Stub Wing (ext.)

Comparisons:

(Higher priority circled)

15/18		
15/2	18/2	
15/20	18/20	2/20

Ranking:

1. Fuel Bay/Cell	score = 3 "18's"
2. Nose Wheelwell	score = 2 "15's"
3. Stub Wing (ext.)	score = 1 "20"
4. Cockpit	score = 0 "2's"

Figure 5.1 Emphasis Curve: A Ranking Technique.

The procedure for scoring the Emphasis Curve begins by circling the most critical item in each pairwise comparison block.

> Counting the number of times an indicator is circled gives its relative importance - the higher the score the more critical. . . . Listing in descending order will give the rank or order of each indicator in relation to the other indicators with respect to the evaluation criteria. [Ref. 1: p. 337]

If modifications are made to the original list of leading indicators this simple method of ranking is used to reprioritize the list.

2. Weighting Indicators

Neri and Law devised an ordinal scale for weighting leading indicators under an assumed curve which they ambiguously refer to as a "Pareto curve". With the

indicators already ranked, the Army logically assumed that indicator weights occurred in the same order. The Army also assumed that a small portion of inspection indicators contributed significantly to the inspection's outcome. This assumption was based on the "80-20" rule as well as management intuition.

> The '80-20' phenomenon is prevalent in many situations. For example, marketing people frequently find that 20% of customers account for 80% of total sales. Universities find that 20% of their courses generate 80% of their student credit hours. [Ref. 38: p. 137]

According to Neri and Law, the 80-20 rule or an approximation of it could be hypothetically expressed as a hyperbolic curve defined by "XY = K"; where "X" denotes the leading indicators ranked in decreasing significance, "Y" denotes the arbitrary weight or utility assigned to indicators, and "K" is the constant which determines the shape of the curve as depicted in Figure 5.2 . They observed that:

> By proper choice of the constant, K, weighting of the indicators can be adjusted to achieve the balance desired. This choice of K becomes a management decision and it is usually related to the desired weight percentage of the first designated number of indicators. [Ref. 1: p. 337]

> The area under the curve is considered unity, and each inspection item's maximum point assignment is numerically proportional to the percentage area of its slice compared to unity [Ref. 2: p. 5].

In other words, each indicator is given a slice under the hyperbolic curve in the order of its ranking as a critical leading indicator. Each slice's area is used as a measure of that indicator's importance in relation to the other indicators.

Figure 5.2 shows a "60-40 curve" to describe the weighting relationship between leading indicators for a P-3. In other words, 40% of the indicators contribute to 60% of the overall material condition of the aircraft. To distribute this chosen relationship over all of the leading indicators the value of K was set to 110.

For example, the area for the eighth most important leading indicator for a P-3 is calculated in the following equation:

$$\frac{\int_7^8 \frac{110}{x}\,dx}{444.69} = \frac{110(\ln 8 - \ln 7)}{444.69} = .033$$

where 444.69 is the value of the total area under the truncated curve

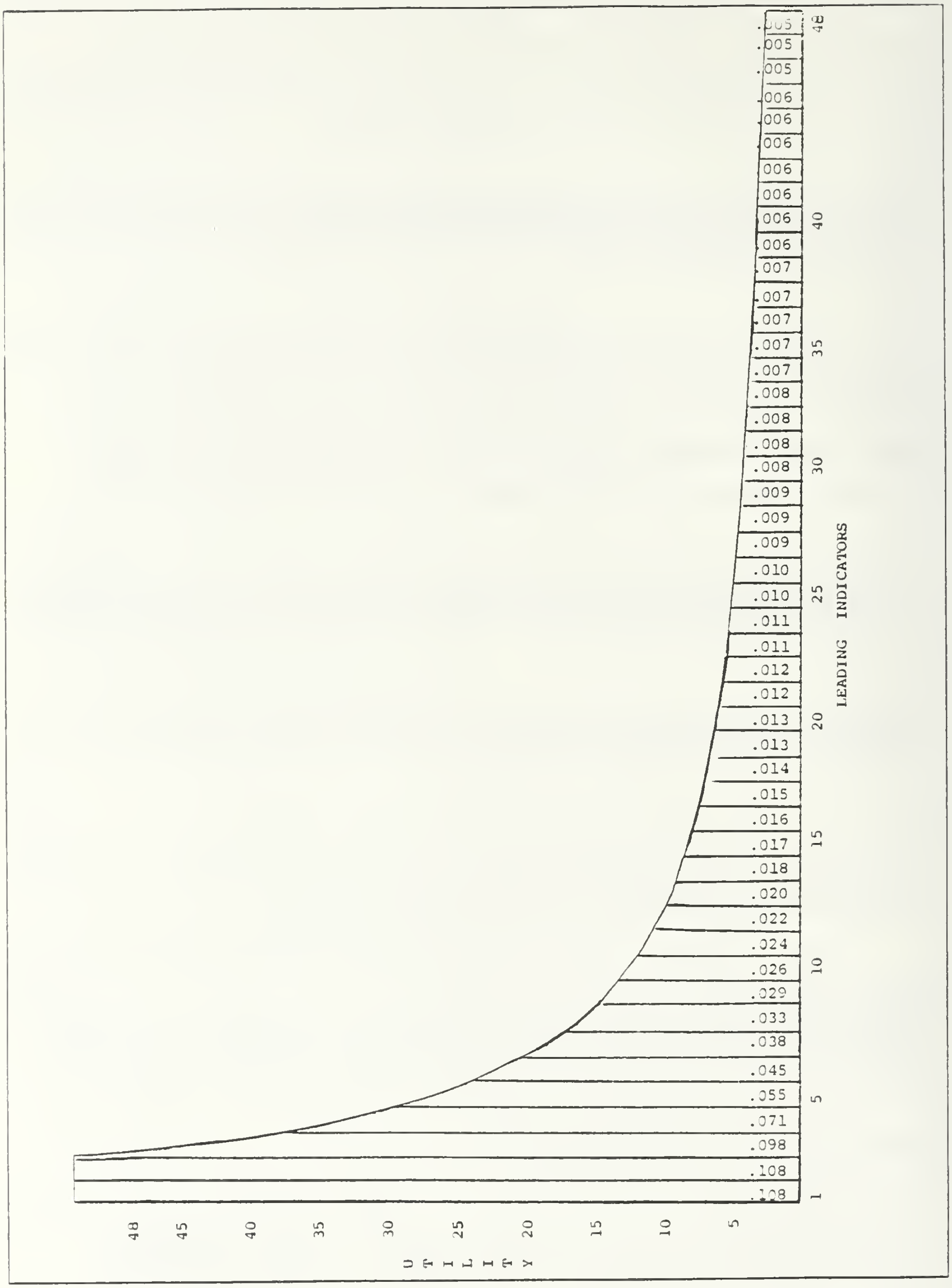

Figure 5.2 Hyperbolic Curve for XY = 110.

in Figure 5.2 .

3. Field Studies

Why did the engineers at the Corpus Christi Army Depot in 1972 and Dale McPherson at NARF Norfolk in 1985 endorse the use of a hyperbolic curve? As one of the Navy's ASPA champions, Dale McPherson, noted in his *Report on the Navy Aircraft Service Period Adjustment Program*,

> . . . the curve has no particular technical merit except that it allows a minority of important defects to generate a majority of points. The relative ranking of defect types could easily be linear, step function, or any other relationship which the CFA (Cognizant Field Authority) considers appropriate for his aircraft. [Ref. 29: p. 41]

However, McPherson was intrigued by Neri and Law's evaluation methodology. It appeared that the Army's quantitative system did correlate reasonably well with the A-6's present qualitative evaluation system. The Army's experimental approach boosted McPherson's confidence in the program since it had been tested in the field. Results from the Army also showed that workload requirements to implement the program were manageable. [Ref. 1: p. 341]

As an experiment McPherson utilized this new quantitative comparison method in parallel with his older qualitative ASPA evaluation. According to recently published results on 23 aircraft, the quantitative ASPA evaluation provided a rough index of aircraft material condition [Ref. 2: p. 11]. McPherson was able to correlate the A-6's material condition with the need for SDLM on either side of a "gray zone" using quantitative indices. (The gray zone is a region of uncertainty where subjective judgements are necessary).

From a survey on the A-6 aircraft, McPherson was also able to determine a point threshold of approximately 300 on a scale of 1 to 1000 by using the evaluation method described in Appendix B, enclosure (1). This threshold was developed over a period of seven months using a NARF version of the Army's profile index. McPherson was satisfied with the survey's results after:

> . . . a histogram was plotted to see if any central distributive tendencies exist in the scores. . . . Although not truly a 'normal' distribution, the distribution shape is coherent and shows a range of scores which presumably represent a range of material conditions in the aircraft sample taken. If the score is considered to be a condition index for the aircraft evaluated, the 'average' aircraft appears to have a condition index of 238. For those who might consider the median score to be representative, the average aircraft may be considered to have a condition index of 253. . . . The point spread between 100% (aircraft service period) adjustments

and no adjustments is 307 minus 253, or 54 points on a 1000 point scale. In the 54 point 'gray area' the adjustment rate is 50%. [Ref. 2: pp. 9-10]

However, McPherson cautions that the present discriminating quality of his numerical index is not calibrated enough to make the final ASPA determination. Additional data is necessary to fine-tune the decision threshold and to create an inspection standard. [Ref. 2: p. 10]

B. PRIORITY FORECASTING AND MANAGEMENT

The Priority Forecasting and Management concept also uses a curve to explain the percentage of deterioration in relation to the percentage of MSI's (maintenance significant items) for military weapons systems. MSI's are items which have significance as determined by a FMEA. AMSI (American Management Systems, Inc.) called their curve the Planning Forecast Curve. Priority Forecasting and Management is a method for analyzing a system's Maintenance Plans (see Chapter II). When this method was applied to an FF-1052 class frigate using reliability centered maintenance, AMSI found conclusive evidence that ". . . a small percentage of the failure modes accounted for most of the support consumed by the equipment or system " [Ref. 39: p. 2].

PFM (Priority Forecasting and Management) is a process which consists of eight steps which are diagrammed in Figure 5.3 [Ref. 39: p. 19]. In Step 4 the figure shows that the Planning Forecast Curve is developed. The Planning Forecast Curve is based on the items's population size and failure rates derived from empirical engineering research. The research data is used to develop a weighting curve for the purpose of forecasting the system's logistics demands by MSI. AMSI created a hypothetical system with ten MSI's in Table 3 [Ref. 39: p. 22], to help explain curve generation. Data in this table was ranked by the products of the MSI's failure rate (failures per five years) and its population size. From this ranking and associated data, the percentage of MSI's, and the percentage of cumulative failure rates is used to generate the system's Planning Forecast Curve. The details of generating these rates are shown in Table 4 . Note in Table 4 [Ref. 39: p. 23], that only 30% of the MSI's account for 70% of the cumulative failures.

Figure 5.4 [Ref. 39: p. 24] plots the last column of Tables 3 and 4 . The result is the Planning Forecast Curve.

According to AMSI:

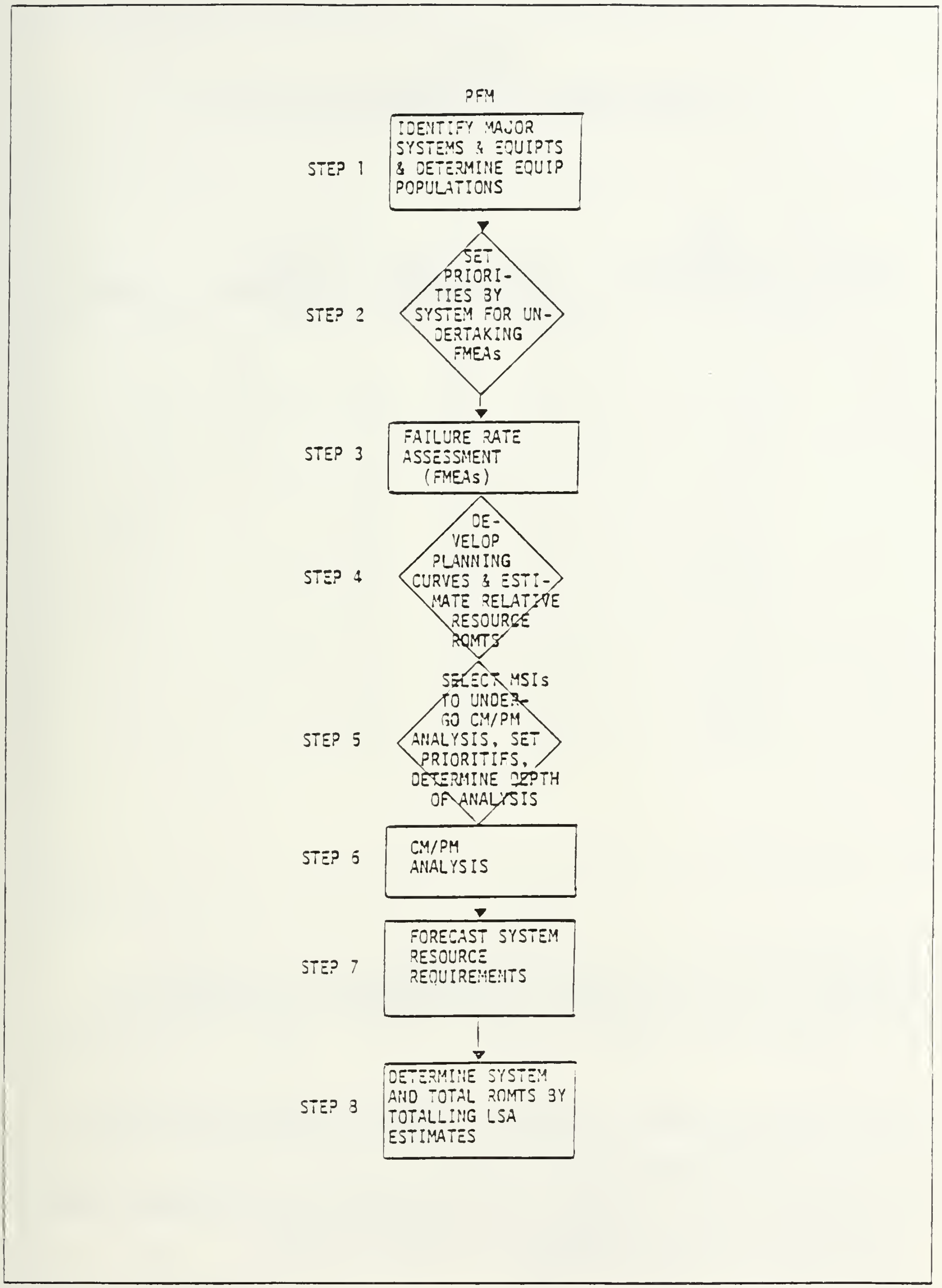

Figure 5.4 Priority Forecasting Management Steps.

TABLE 3

FMEA DATA FOR A HYPOTHETICAL SYSTEM

MSI	MSI POPULATION	MSI FAILURE RATE	PRODUCT	RANK
1	1	.36	.36	7
2	5	.50	2.50	3
3	1	.20	.20	9
4	2	2.05	4.10	2
5	1	.10	.10	10
6	12	.20	2.40	4
7	1	.40	.40	6
8	4	1.20	4.80	1
9	2	.16	.32	8
10	12	.10	1.20	5

The Planning Forecast Curve is an excellent predictor of relative resource requirements among a set of maintenance significant items. With minor modifications, it can also be used to predict which items will have the greatest impact on operational availability. The predictive powers make it a very valuable tool for logistics planners. [Ref. 39: p. 50]

AMSI's method is similar to McPherson's quantitative method. Both methods:

- Use of an approximation of the 80-20 rule.
- Rank items which are significant to the maintenance of a major weapon system.
- Are based in principle on Reliability Centered Maintenance.
- Seek efficiency through forecasting.
- Require feedback in the form of a historical database.

TABLE 4
PLANNING FORECAST CURVE DATA

MSI	CUMULATIVE FAILURE RATE	% MSI's	% CUMULATIVE FAILURE RATE
8	4.80	10	29.3
4	8.90	20	54.3
2	11.40	30	69.6
6	13.80	40	84.2
10	15.00	50	91.6
7	15.40	60	94.0
1	15.76	70	96.2
9	16.08	80	98.2
3	16.28	90	99.4
5	16.38	100	100.0

- Have been tested with positive preliminary results.

C. P-3 APPLICATION

McPherson's quantitative method was chosen as the model for an improved P-3 ASPA evaluation form for four reasons. The first reason for this author's selection of McPherson's quantitative method over the others discussed in Chapters IV and V is its inherent testability or applicability. McPherson's method is highly applicable to Navy bomber airframes. Many of the "bugs" have been eliminated from the A-6 ASPA model by trial and error.

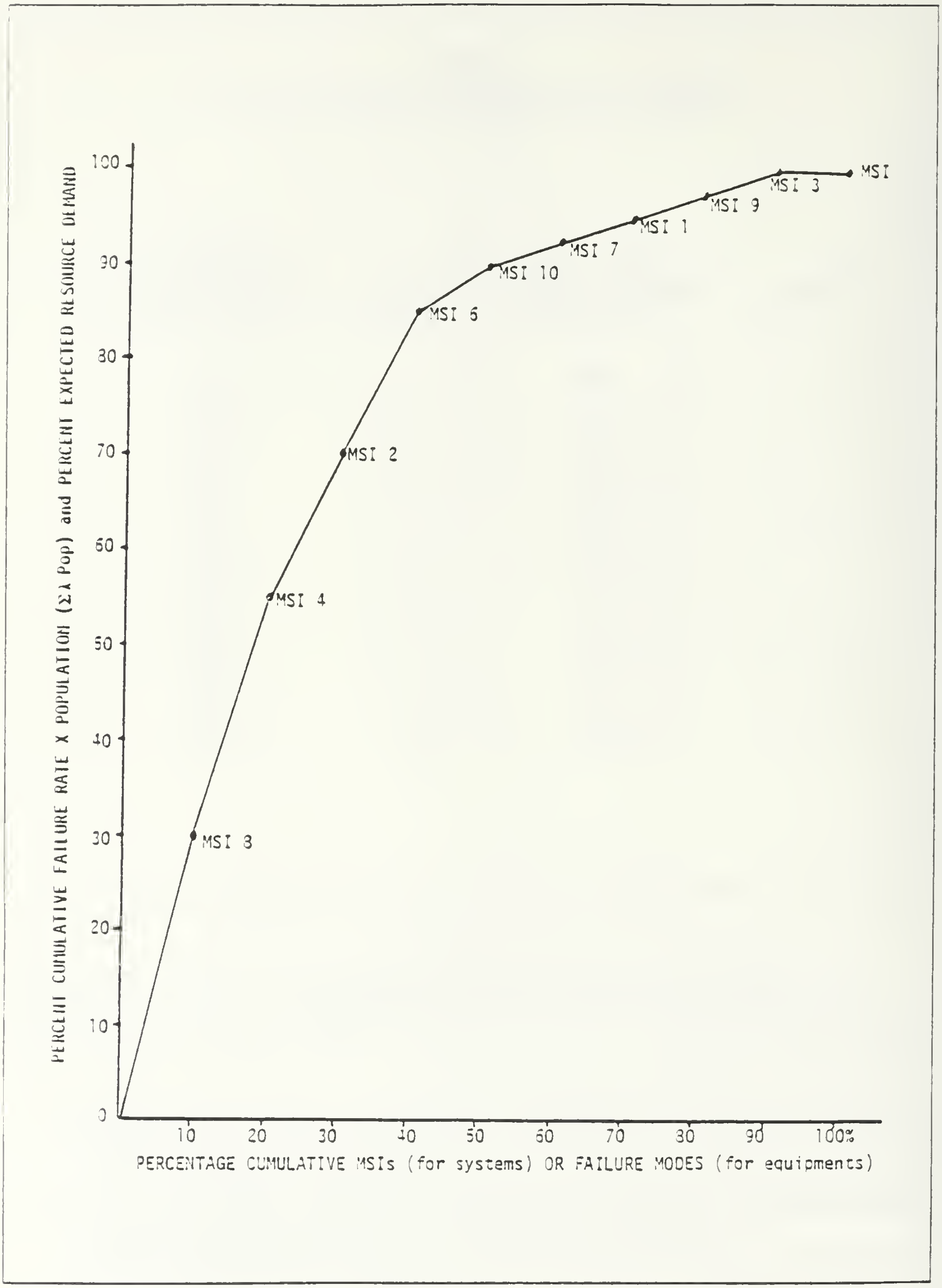

Figure 5.4 Sample Planning Forecast Curve.

The second reason was acceptability. When the AHP was proposed as a plausible model, local NARF logisticians could not be convinced of its merits and therefore would be less likely to construct a valid decision structure. This structure or hierarchy is sensitive to the expert's opinion of the research. The iterative nature of the AHP was also likely to lose critical interest from busy experts halfway through the structuring process.

The third reason was practicality. While AMSI's empirical method appeals to this author, neither the database, expertise, nor the funding for contractor assistance was available.

The final reason was the limited amount of time allocated for thesis research. Of the previously mentioned methodologies, only McPherson's method was simple enough for one researcher to complete an inspection form worthy of testing in the time allowed.

The intention of this author was to solicit expert opinion at the two primary sites where P-3 SDLM was performed. From these opinions, a list of 48 leading indicators were compiled primarily from well-known SDLM work areas which are labelled in Figure 5.5 . Coincidentally, McPherson used the same number of leading indicators for the A-6. These indicators or inspection tasks were ranked using Neri and Law's method for pairwise comparisons. An abbreviated example of this method using responses from P-3 P & E's is found in Figure 5.1 .

All available P-3 P & E's were asked to compare the 48 leading indicators. Once the surveyed comparisons were totalled and differing P & E's responses were agreed upon, a final ranking of leading indicators was presented to the P & E's. On the basis of McPherson's technique and K = 110, the curve was plotted using the ranking from the P-3 P & E's comparisons. Plotting the resulting curve helped to explain the relationship between leading indicators and the overall evaluation score. The P & E's agreed that the final rankings appeared to be satisfactory.

As was shown in Figure 5.2 , a decimal value was calculated for each leading indicator with the total of the decimals equalling one. To avoid working with fractions on the final evaluation form, each decimal value was multiplied by 1000, the maximum score allowed under the arbitrary ASPA standard (OPNAVINST 3110.11 series). Theoretically, the total of these weights could be any number, as long as it is kept constant for the area under the curve.

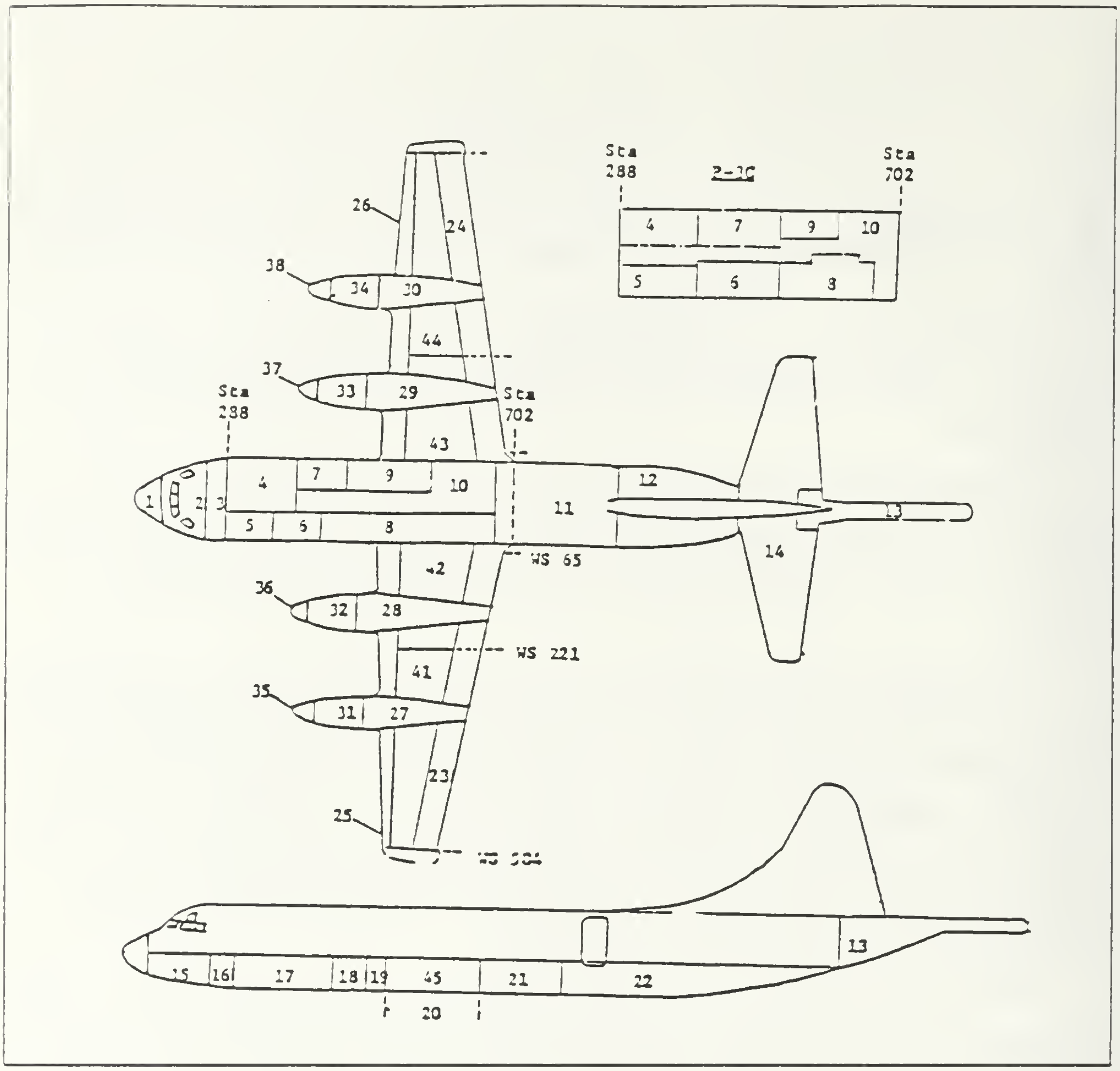

Figure 5.5 P-3A/B/C Areas Used in New ASPA Evaluation Form.

Next, P & E's were asked to divide each area's maximum score into distinguishable levels and typical defects. Unfortunately, due to time constraints of the P & E's, this part of the research was not completed. Therefore, as an arbitrary estimate, five levels of defect were assumed for each leading indicator. The least deteriorated level arbitrarily received 20% of the maximum score allocated to each indicator. The other level's scores increased incrementally by 20%. Therefore, the worst level of deterioration, level 5, received 100% of the score as seen in Figure 5.6 . For example, the sixth most important leading indicator for the P-3 was the Starboard

Rank	Leading Indicator	Area	Point Value for Level of Defect				
			Low 1	2	3	High 4	5
1	Overall condition	n/a	22	43	65	86	108
2	Overall corrosion	n/a	22	43	65	86	108
3	Port wing-aft shear beam	23	20	39	59	78	98
4	Stbd wing-aft shear beam	24	14	28	43	57	71
5	Port outer wing (ext)	25	11	22	33	44	55
6	Stbd outer wing (ext)	26	9	18	27	36	45
7	Overall fuel leaks	n/a	8	15	23	30	38
8	Stbd inbrd fuel tank	43	7	13	20	26	33
9	Port inbrd fuel tank	42	6	12	17	23	29
10	Paint condition	n/a	5	10	16	21	26
11	Stbd outbrd fuel tank	44	5	10	14	19	24
12	Stbd fwd obs/head area	4	4	9	13	18	22
13	Port outbrd fuel tank	41	4	8	12	16	20
14	No 2 NAC & MLG well	28	4	7	11	14	18
15	N0 3 NAC & MLG well	29	3	7	10	14	17
16	Hor/vert stabilizer	14	3	6	10	13	16
17	No 1 nacelle/tailpipe	27	3	6	9	12	15
18	No 4 nacelle/tailpipe	30	3	6	8	11	14
19	Waist cabin(under floor)	22	3	5	8	10	13
20	Stub wing fuel tank	45	3	5	8	10	13
21	APU/air cond area	16	2	5	7	10	12
22	NLG well & air cond	15	2	5	7	10	12
23	Fuel bay & bladder cell	18	2	4	7	9	11
24	Cockpit Area	2	2	4	7	9	11
25	Stub wing(ext)	20	2	4	6	8	10
26	Flight engineer area	3	2	4	6	8	10
27	Radome & press bulkhead	1	2	4	5	7	9
28	No 3 QCU & acc	33	2	4	5	7	9
29	No 2 QCU & acc	32	2	4	5	7	9
30	No 4 QCU & acc	34	2	3	5	7	8
31	No 1 QCU & acc	31	2	3	5	6	8
32	Service bay	19	2	3	5	6	8
33	Hydraulic service center	21	2	3	5	6	8
34	Port operator sta	8	1	3	4	6	7
35	Elect load center	9	1	3	4	6	7
36	Maint records analysis	n/a	1	3	4	6	7
37	Aft waist	12	1	3	4	6	7
38	Forward waist	11	1	3	4	6	7
39	Walkway	10	1	2	4	5	6
40	Port fwd operator sta	5	1	2	4	5	6
41	Stbd fwd elec racks	7	1	2	4	5	6
42	Port fwd elec racks	6	1	2	4	5	6
43	Tail cone & stinger	13	1	2	4	5	6
44	Bomb bay	17	1	2	4	5	6
45	No 2 prop & spinner	36	1	2	4	5	6
46	No 1 prop & spinner	35	1	2	3	4	5
47	No 3 prop & spinner	37	1	2	3	4	5
48	No 4 prop & spinner	38	1	2	3	4	5

Figure 5.6 New P-3 ASPA Evaluation Form.

Outer Wing (external) with a maximum score of 45. Primary defects in this critical area could be cracks or corrosion. Each of these defects has five distinguishable levels of deterioration. The more severe level for either defect takes priority. The five levels of deterioration and their score for this leading indicator are:

1. Minor, repair not required (score of 9).
2. Requires organizational repair (score of 18).
3. Requires routine depot repair (score of 27).
4. Requires engineered depot repair (score of 36).
5. Severe condition, unsalvageable (score of 45).

If, for example, the P & E found level 2 corrosion and level 3 cracks on the Starboard Outer Wing (exterior), a score of 27 would be assigned to this portion of the ASPA evaluation form.

While this author arbitrarily assigned all leading indicators five levels of deterioration, any number and mixture of appropriate levels is feasible. Once the appropriate number of levels and type of deterioration are assigned to each leading indicator, the entire evaluation form should be placed in the same order that the P & E would logically perform the ASPA inspection. A logical order will enhance the credibility of the new evaluation form in the eyes of the P & E's.

The final quantitative evaluation form should look like Figure 5.6 because its format is very easy to use. The P & E merely circles the most severe defect in each leading indicator's row which is observed on the P-3 being inspected. Circled values are summed. The total value is returned to the NARF and compared with the total values reported on other P-3's. After several evaluations, a trend should appear. From this trend, a numerical criterion should be derivable to help the CFA manager decide which P-3's to admit to SDLM.

In conclusion, it should be stressed that quantitative analysis is not intended to furnish a decision, instead it yields information which will facilitate decisions. In the words of M. J. Cetron, "Data plus analysis yields information. Information plus judgement yields decisions." [Ref. 40: p. 64]

VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

Every attempt has been made to create a plausible expert model for the ASPA management decision. By exploring current management science methodologies, a practical model patterned after quantitative ASPA evaluation methods being tested at NARF Norfolk and at Army Depot Corpus Christi is proposed. More importantly, the management at NARF Alameda is afforded the opportunity to rethink a difficult problem which has stymied many Navy logisticians to date.

B. CONCLUSIONS

The following conclusions are derived:

1. The most important consideration for the manager attempting to refine a process is to beware of the exceptions to the rule. While the number of leading indicators listed in Figure 5.6 covers many of the defects visible to the P & E, additional indicators of imminent deterioration will undoubtedly surface and should be duly noted on the evaluation sheet. These exceptions may override the weights applied to the quantitative model. If so, safety factors usually take priority over economics and availability decision criterion. The experienced, intuitive skills and "common sense" of the structural engineer, production manager, P & E, and when necessary, higher authority, should be relied on in these situations.
2. Leading indicators which are economic depot drivers may require only one inspection which can be performed during the ASPA evaluation. Safety critical items conventionally require more inspections and should be evaluated at the organizational level. However, to perform the ASPA inspection correctly, NARF P & E's should have the expertise required to evaluate economic as well as safety consequences.

C. RECOMMENDATIONS

The product of this study, Figure 5.6 , is presented for logistics analysis purposes only. Without testing this product in the fleet environment, it would be unwise to endorse this variation over the P-3 LES in current use. Additional analysis is recommended to:

1. Assign each leading indicator the appropriate levels and kinds of defects.
2. Determine the ASPA decision criterion on a scale of 0 to 1000.
3. Train P & E's to use the new format in Figure 5.6 with confidence.
4. Corroborate the constant, K, applied to shape the hyperbolic or other suitable weighting curve.
5. Eliminate insignificant leading indicators and add newer, more significant indicators.

For further research into the economic aspects of the ASPA problem, it is recommended that the present Master Data Record (cost database at the NARF) be applied to the zones identified in the quantitative ASPA evaluation in Figure 5.6 . The total cost of SDLM (in present value form) could serve nicely as an historical base. If this base is normally distributed, one can probably verify the weight and sensitivity of each zone in a multiple regression analysis. For each aircraft use zonal cost data as independent variables to predict the total cost of SDLM, the dependent variable. The economic approach to the ASPA problem appears to be the direction that NARF managers are headed. Economic analysis would greatly enhance the predictability of the ASPA decision.

APPENDIX A

P-3 LOCAL ENGINEERING SPECIFICATION

DEPARTMENT OF THE NAVY
Naval Air Rework Facility
Naval Air Station
Alameda, California 94501

NARF-322-PHD
18 September 1985

TITLE: P-3 Local Engineering Specification

IDENTIFICATION/CLASSIFICATION: GEN/AL 12-9-0110

PUBLICATION: None

SUBJECT: P-3 Series Aircraft Service Period Adjustment (ASPA) Inspection Requirements

REFERENCES:
- (a) OPNAVINST 3110.11 series
- (b) NAVAIR 01-75PAC-6 P-3 PMIC (Periodic Maintenance Information Cards)
- (c) NA01-75PAA-3-1, P-3 Aircraft Structural Repair Manual
- (d) NA01-75PAA-3-2, P-3 Aircraft Structural Repair Manual
- (e) NAVAIR 01-75PAC-6-3, P-3 Daily/Special/Preservation Requirements Cards
- (f) P-3 LPS/AL 02-2-0150, Aircraft Exterior Paint Systems; evaluation criteria for the stripping of
- (g) P-3 LES/AL 18-5-0100, Aileron Lower Inner Skins; standard repair member for
- (h) P-3 LES/AL 18-5-0130, Aileron Intercostals; replacement for
- (i) P-3 LES/AL 17-2-0060, Inboard Nacelle Shroud Angle P/N's 812789-7 and -8; repair of
- (j) P-3 Airframe Bulletin 193, Nose Landing Gear Upper Drag Strut Inspection and Repair
- (k) P-3 LES/AL 23-2-014C, NLG(Nose Landing Gear) Steering Housing Surface Corrosion; Repair of

ENCLOSURE:
- (1) P-3 ASPA Aircraft Preparation Requirements
- (2) ASPA Inspection Summary Report Form
- (3) ASPA Inspection Results Report Form

1. PURPOSE: To determine current overall material condition of P-3 aircraft. The material condition will determine aircraft suitability for a 12 month service period adjustment within the guidelines of reference (a).

2. CANCELLATION: P-3 LES GEN/AL 12-9-0100 Dated 2 November 1984

3. BACKGROUND: Reference (a) promulgated operational and rework cycles for the P-3 aircraft. Operation of an aircraft beyond the specified service period requires TYCOM review and OPNAV approval. Adjustments to the service period are contingent upon the material condition of the aircraft. The following inspections and enclosed report survey document this condition.

4. APPLICATION: All P-3A/B/C and derivative series aircraft.

5. SPECIAL TOOLS AND TEST EQUIPMENT: None.

6. SPECIAL MATERIALS: None.

7. EFFECTIVE DATE: As soon as possible but not later than 30 Sep 1985.

8. INSTRUCTIONS:

8.0 GENERAL:

8.0.1 Notify NARF Alameda code 322 at least three weeks prior to performing this inspection. Include BUNO, current Period End Date (PED), number of previous ASPAs granted this tour and location and date of inspection.

8.0.2 The following instructions are guidelines for the Aircraft Service Period Adjustment (ASPA) inspection. These instructions represent the minimum inspection to be performed prior to granting a service period adjustment. Perform the ASPA inspection at a site designated by the Aircraft Controlling Custodian. A depot field team composed of an aircraft planner and estimator and other appropriate personnel as required shall perform this inspection. The minimum access requirements to accomplish this inspection are included as enclosure (1). Enclosure (2) is the ASPA Inspection Summary Report Form. Enclosure (3) is the ASPA Inspection Rusults Form which will be used to determine the major driving factors which reduce tour length and service life. Additional inspections and further disassembly may be accomplished at the discretion of the Planner and Estimator.

NOTE

Extensive repaint on the exterior is a strong indication of exterior corrosion problems. If this condition exists, the planner should interview squadron corrosion control personnel to ensure that this repaint is in fact an indication of significant corrosion and not an attempt to erase "Black Circles" which routinely appear around rivet heads.

8.0.3 If the aircraft being inspected shows extensive signs of corrosion over the entire airframe, this should be considered a strong justification for recommending against ASPA.

8.0.4 If the aircraft being inspected shows extensive signs of exterior corrosion or fails the paint tape test, but is recommended for ASPA, a recommendation for ISR repaint should be included with the ASPA recommendation report. The recommendation report should note that logistic limitations may prevent ISR repaint, and that failure to repaint the aircraft could result in an increase in the operating and rework costs.

8.0.5 The overall material condition of an aircraft reflects a combination of the quantity and nature of defects found during the ASPA inspection and the information found during the review of aircraft logbooks and interviews with squadron maintenance personnel. The recommendation to adjust or not adjust the PED is based on this overall material condition as follows:

a. A recommendation to adjust the PED is a statement by the ASPA team that the aircraft may be safely operated for 12 months beyond its current PED without experiencing disproportionate economic or readiness consequences. This adjustment recommendation is an evaluation of the overall condition of the aircraft, and is therefore not contingent upon the correction of any single defect.

b. A recommendation not to adjust the PED is a statement that the

aircraft cannot be operated safely for a full year beyond its current PED without experiencing disproportionate economic or readiness consequences.

8.1. Aircraft Record analysis:

8.1.1 Review Maintenance Action Forms (OPNAV 4790/41), Naval Aircraft Flight Records (Yellow Sheets, OPNAV 3760/2), Corrosion Control Records, and the aircraft log book for identification of chronic problem areas, unusual conditions, or significant maintenance actions (including structural repairs). Analyze this historical data for chronic system and component trouble which need added emphasis during aircraft examination and for significant rise in corrosion man-hours in the last year. Whenever possible, interview squadron maintenance personnel familiar with the aircraft. Gain additional information about potential problem areas to help determine extent of corrective action required for service period adjustment.

8.1.2 Review the PMIC, reference (b), scheduled removal components for high time components.

8.1.3 Screen the technical directives section OPNAV 4790/24A or List 2 of the aircraft log book. Determine incorporation status of technical directives which would affect aircraft suitability for service period adjustment.

8.1.4 Record the following data in the appropriate box on enclosure (2) report summary form:

a. Aircraft TMS and bureau number and custodian.
b. Current PED, tour number and number of ASPAs this tour.
c. Total flight hours and flight hours in current tour.
d. Total operational months and total months in current tour.
e. Non-aging time since last SDLM.
f. Last SDLM completion date and last ASPA completion date.
g. Number of landings during current tour.
h. Number of overweight and/or hard landings.
i. Most recent phase inspection, date and flight hours at phase.

<u>NOTE</u>

Repair instructions for structural components are found in references (c) and (d). Where appropriate, additional references are noted.

8.2 Ensure aircraft has been washed in accordance with reference (e). Visually inspect the entire paint system for evidence of paint lifting (poor adhesion), blisters, checked coatings, erosion, and corrosion, especially around fasteners. Perform wet and dry tape test as outlined in reference (f). Do not consider cosmetic appearance.

8.3 Check Fuel Tank Integrity:

<u>NOTE</u>

It is the responsibility of the Planner and Estimator to ensure that the following task is carried out in an appropriate sequence to provide adequate results. As such, the fueling/ defueling sequence is at the discretion of the Planner and Estimator.

8.3.1 Fill fuel tanks to maximum capacity. Maintain tanks at capacity for a minimum of eight hours. Perform a visual inspection of the following areas for fuel leakage:

NOTE

When fuel leaks are found, classify using criteria of reference (c) section X. Where possible determine the source of the leak.

a. Wing planks.
b. Front and rear spars.
c. Fuel tank access panels.
d. Wing tip bulkhead.
e. Fuselage areas adjacent to fuel tanks 5 and 5A.
f. Main landing gear trunions.
g. Wing to fuselage fillets.

8.3.2 Drain all tanks.

8.4 Inspect Wing Structure:

8.4.1 Visually examine the following items for cracks and corrosion:

a. Front rear spars and spar fittings.
b. External stores attachment fastener holes.
c. Flap track attachment fittings and carriages.
d. Wing planks.

8.4.2 Perform general structural, attaching hardware, and control linkage/cables examination on the following items:

a. Aileron.

NOTE

Reference (g) provides a standard repair member for the aileron lower inner skins. Reference (h) provides repair instructions for cracked or buckled aileron intercostals.

b. Aileron tabs.
c. Wing flap.
d. Tailpipe shroud.

NOTE

Reference (i) describes the repair part for the nacelle shroud angle.

e. Nacelle firewall, fireshield and forward tailpipe support structure.
f. Trailing edge ribs.

NOTE

Reference (c) provides installation data for wing trailing edge rib repair kits.

g. Leading edges.

8.4.3 Perform general integrity examination of the following:

a. Nacelle wiring and tubing.
b. Exposed wiring.

8.4.4 Examine areas of previous structural repairs and reinforcements for cracking, deformation, or evidence of loose and working fasteners.

8.5 Inspect Fuselage and Empennage Structure:

8.5.1 Visually examine the following items for cracks and corrosion:

a. Rear main ring fittings.
b. Forward main ring fittings.

NOTE

Repair of cracked main ring fitting is described in reference (d).

c. Vertical fin attach fittings.
d. Forward RH jack pad fittings part numbers 917693 & 917694.

8.5.2 Perform general structural, attaching hardware, and control linkage/cables examination on the following items:

a. Doors and linkages.
b. Elevator.
c. Elevator tabs.
d. Rudder.
e. Rudder tabs.
f. Aft fuselage at empennage carrythrough structure (aft of FS 1117).
g. Aft belly compartment and hydraulic service center (aft of wing center section rear spar beam).
h. Battery support.
i. Bomb Bay.
j. Both sides of aft pressure bulkhead FS 1117 (move flight controls in order to inspect flight control cables running through bulkhead).
k. Pressure deck above APU compartment for evidence of heat damage.
l. Horizontal stabilizer interior (through access holes).

8.5.3 Perform general integrity examination of all exposed wiring. In particular, look for heat damage, chafing, abrasions, pinched wire, broken wire etc.

8.5.4 Examine areas of previous structural repairs and reinforcements for cracking, deformation, or evidence of loose and working fasteners.

8.6 Inspect Landing Gear.

8.6.1 Perform general structural, attaching hardware, and control linkage/cables examination on the following items:

a. NLG steering system.
b. Main landing gear.
c. Doors and linkages.
d. Nose landing gear.

NOTE

Incorporate reference (j) if appropriate for the NLG upper drag strut.

8.6.2 Inspect sealant on NLG steering housing motor nuts. If sealant is not present and intact, flourescent dye penetrant inspect the thread and thread relief areas of the NLG steering cylinder housing for evidence of cracking.

NOTE

Reference (k) provides repair procedure.

8.6.3 Inspect Main Landing Gear for leaks.

8.6.4 Inspect all landing gear pistons for damaged chrome.

8.6.5 Perform general integrity examination of all exposed wiring.

8.6.6 Examine areas of previous structural repairs and reinforcements for cracking, deformation, or evidence of loose and working fasteners.

8.6.7 Record overhaul due dates and serial numbers of all landing gear. Advise custodian and functional wing maintenance officers if overhaul due date(s) (132 months) will expire prior to revised PED.

8.7 Contact the P-3 Aircraft Systems Engineering Division if any unusual damage not associated with aircraft age or service history (eg. Indication of primary structure over-stress) is found. Engineering will provide subsequent inspections and repairs.

8.8 List all defects on standard E & E Aircraft Discrepancy Record. Include task number or special task which revealed defect. Identify all defects requiring depot resources to repair. Report must be signed by depot Planner and Estimator and by an authorized representative of the controlling custodian. Submit completed form to the controlling custodian and to the P-3 Weapon System Engineering Division (Code 320).

NOTE

Classification of defects are as follows:

DEFECT: Any deviation of a unit or part from specified requirements.

DEFECT, CRITICAL: A defect that constitutes a hazardous or unsafe condition, or as determined by experience and judgment could conceivably become so, relative to its deleterious effect on the prime intended function, safety of flight or mission capability of the aircraft or its operating personnel.

DEFECT, MAJOR: A defect, other than critical, that could result in failure or materially reduce the useability of the unit or part for its intended purpose.

DEFECT, MINOR: A defect that does not materially reduce the useability of the unit or part for its intended purpose, or is a departure from standards which has no significant bearing on the effective use or operation of the unit part.

8.9 The Planner-Estimator on the depot team will prepare a Naval message or Speedletter as appropriate at the inspection site. Transmit the message to the TYCOM/aircraft custodian, NALC-220, and NAVAIREWORKFAC Alameda. Include the following information in the message text:

a. TMS and BUNO
b. Current PED
c. Tour number
d. Total operating service months/ operating months this tour
e. Total operating hours/ operating hours this tour
f. Total landings this tour/ hard or overweight landings this tour
g. ASPA inspection start date/ completion date
h. Number of ASPA inspections this tour
i. Number of man-hours spent on inspection - org / int / depot
j. Quantity of defects discovered listed by category, i.e., critical, major, minor, and description of all critical or major defects requiring depot resources to repair. Identify critical defects with "CR" and major defects with "MA". Provide manhour and material estimates for depot defect correction.
k. Recommendation regarding suitability of the aircraft for a 12 month tour extension. Provide a narrative stating the rationale for the recommendation.

NOTE

If a speedletter is used to transmit the results of the inspection, the appropriate TYCOM shall be notified of these results by phone within 5 working days of completion. Points of contact are:

To prepare the aircraft for ASPA inspection, wash the aircraft in accordance with NAVAIR 01-75PAA-6-3 wash requirements and then open the following panels and doors (Refer to NA01-75PAA-2-1):

NOTE

> At the option of the planner and estimator on the depot inspection team, additional areas may require examination to determine extent of defect(s). Accordingly, additional panels and access doors may be identified for removal or opening.

a. Nose radome.
b. Battery down/ APU door open.
c. Bomb bay doors.
d. Oil cooler doors.
e. Fuselage access panels (F11; F23; F108; F111; F1271; F128R).
f. Nacelle access panels (N107 L&R; N132 L&R; and N133 L&R).
g. Hinged leading edges (W24 L&R; W25 L&R).
h. Leading edge access panels. (W27 L&R; W28 L&R; W30 L&R; W32 L&R; W34 L&R; W35 L&R)
i. Flap well access doors. (W6 L&R; W7 L&R; W8 L&R; W9 L&R; W10 L&R; W11 L&R; W12 L&R)
j. Aileron well access doors. (W14 L&R; W15 L&R; W16 L&R; W17 L&R; W18 L&R)
k. Aileron access door. (W13 L&R)
l. QECK access doors (P1 & P2) and access panels (N117 L&R; N118 L&R; N141 L&R; N142 L&R).
m. Tailpipe turtlebacks. (N151 L&R; N152 L&R; N153 L&R; N154 L&R; N155 L&R)
n. Remove wing tips.
o. Remove wing stores pylons and wing stores fittings plugs.
p. Hydraulic center access hatch. (F21)
q. Vertical stabilizer side doors. (E8; E9; E10)
r. Horizontal stabilizer access panels.(E116 L&R; E6 L&R; E117 L&R; E4 L&R; E120 L&R; E122 L&R; E124 L&R; E126 L&R; E128 L&R; E130 L&R; E132 L&R)
s. Lower empennage access door. (E1)
t. Extend aft radome (stinger).
u. Propeller afterbody top halves.
v. Lower firewall panels.
w. Engine pie pans (4 per engine).
x. Lower inboard and outboard fire shield panels (2) (Nacelles 1 & 4). HRD access panels and upper and lower fire shield panels (4) (Nacelles 2 & 3).
y. LH lower wing to fuselage fillet FS 553-571 (P/N 900545-3, 900545-21,926323-3 or 926323-103). RH lower wing to fuselage fillet FS 533-571 (P/N 939484-105, 939484-107 or 937859-103).
z. Two center floorboards adjacent to aft pressure bulkhead.
aa. Floor boards over APU exhaust.
bb. Floor boards over RH forward Jack/mooring fitting.

Ensure that all access panels, doors and other items removed or opened in preparation for the ASPA inspection are properly secured prior to the next flight.

enclosure (1)

ASPA INSPECTION SUMMARY REPORT FORM

Date_______________

TMS: ____________

BUNO: ____________

CUSTODIAN: ________________ NUMBER OF PREVIOUS ASPAs THIS TOUR: __________

CURRENT TOUR NUMBER: ____________ PERIOD END DATE: ________________

TOTAL FLIGHT HOURS: ____________ FLIGHT HOURS THIS TOUR: ____________

TOTAL OPERATING MONTHS: __________ OPERATING MONTHS THIS TOUR: __________

NON-AGING TIME SINCE LAST SDLM (OR SINCE NEW IF NO PREVIOUS SDLM): __________

DATE OF LAST SDLM: ________________

NUMBER OF LANDINGS THIS TOUR: _________ OVERWEIGHT: _________ HARD: _________

NUMBER OF O/I DEFECTS: ______ CRITICAL: ______ MAJOR: ______ MINOR: _______

NUMBER OF DEPOT DEFECTS: ______ CRITICAL: ______ MAJOR: ______ MINOR: _______

LAST PHASE INSPECTION: ______ PERFORMED ON DATE: ________ FLIGHT-HOURS: ______

VIDS/MAFS REVIEW COMMENTS: ____

FLIGHT RECORDS REVIEW COMMENTS: ____

LOGBOOK REVIEW COMMENTS: ____

HIGH TIME COMPONENTS: ____

ENCLOSURE (2)

ASPA INSPECTION SUMMARY REPORT FORM

AIRCRAFT TMS:______ BUNO:_______ DATE OF INSPECTION:______________

EXTERIOR PAINT

DRY TAPE TEST: PASSED FAILED

WET TAPE TEST: PASSED FAILED

OVERALL CONDITION: EXCELLENT GOOD FAIR POOR

APPARENT PERCENTAGE OF ORIGINAL PAINT REMAINING INTACT: ______________

COMMENTS: ____

____

____

LAST OVERHAUL DATE AND S/N FOR LANDING GEAR: NOSE GEAR: ____________

LEFT MLG: ____________________ RIGHT MLG: ____________________

NUMBER OF DEFECTS REQUIRING INTERMEDIATE LEVEL REPAIR:_______

DEPOT LEVEL REPAIRS REQUIRED:____

____

____

____

____

ESTIMATED MAN-HOURS FOR DEPOT DEFECT CORRECTION:_______ TAT:_______ DAYS

START DATE:____________ ESTIMATED COMPLETION DATE:______________

_____ I RECOMMEND THIS AIRCRAFT FOR A 12 MONTH SERVICE PERIOD ADJUSTMENT.

_____ I DO NOT RECOMMEND THIS AIRCRAFT FOR A 12 MONTH SERVICE PERIOD ADJUSTMENT.

NARRATIVE RATIONALE FOR RECOMMENDATION:______________________________

____

____

____

____

____

____

____________________________ ____________________________
CUSTODIAN MAINTENANCE OFFICER PLANNER AND ESTIMATOR

ORGANIZATION: ____________ FACILITY: ____________

ENCLOSURE (2)

ASPA INSPECTION RESULTS REPORT FORM

AIRCRAFT TMS:______ BUNO:_______ DATE OF INSPECTION:______________

INSTRUCTIONS

Inspect the aircraft in accordance with the ASPA LES. Provide the requested information in the space provided. Where a ranking is requested, 0 is the best overall condition and 9 is the worst overall condition. In the "RANK" column, provide the relative ranking importance for each item in terms of that items negative impact on the overall condition of the aircraft. For the "RANK" column, use a "0" for no impact, and a "9" for the most severe impact. These data sheets will be used to help evaluate the effectiveness of the ASPA program as it applies to the P-3 model aircraft.

RANK	PARAGRAPH	DESCRIPTION	RATING OR DATA
____	8.1	FLIGHT HOURS LAST 90 DAYS	ACFT:________ SQDRN AVG:_______
____	8.1	FLIGHT HOURS LAST 12 MOS.	ACFT:________ SQDRN AVG:_______
____	8.1	CORR CTRL HOURS LAST 90 DAYS	ACFT:________ SQDRN AVG:_______
____	8.1	CORR CTRL HOURS LAST 12 MOS.	ACFT:________ SQDRN AVG:_______
____	8.1	FUEL LEAK HOURS LAST 90 DAYS	ACFT:________ SQDRN AVG:_______
____	8.1	FUEL LEAK HOURS LAST 12 MOS.	ACFT:________ SQDRN AVG:_______
____	8.2	FUSELAGE PAINT CONDITION	0 1 2 3 4 5 6 7 8 9
____	8.2	WING PAINT CONDITION	0 1 2 3 4 5 6 7 8 9
____	8.2	SOLAR CAP PAINT CONDITION	0 1 2 3 4 5 6 7 8 9
____	8.2	WHEEL/ FLAP WELL PAINT CONDITION	0 1 2 3 4 5 6 7 8 9
____	8.2	EMPENNAGE PAINT CONDITION	0 1 2 3 4 5 6 7 8 9
____	8.2	OVERALL PAINT CONDITION	0 1 2 3 4 5 6 7 8 9
____	8.2	PERCENT PAINT TOUCH-UP	0 10 20 30 40 50 60 70 80 90
____	8.3.1a	FUEL LEAKS TANK #1 TOP PLANK	0 1-2 3-5 5-8 8-10 11 OR MORE
____	8.3.1a	FUEL LEAKS TANK #1 LOW PLANK	0 1-2 3-5 5-8 8-10 11 OR MORE
____	8.3.1b	FUEL LEAKS TANK #1 FOR SPAR	0 1-2 3-5 5-8 8-10 11 OR MORE
____	8.3.1b	FUEL LEAKS TANK #1 AFT SPAR	0 1-2 3-5 5-8 8-10 11 OR MORE
____	8.3.1c	FUEL LEAKS TANK #1 ACCESS	0 1-2 3-5 5-8 8-10 11 OR MORE
____	8.3.1d	FUEL LEAKS TANK #1 TIP	0 1-2 3-5 5-8 8-10 11 OR MORE

Enclosure (3)

ASPA INSPECTION RESULTS REPORT FORM

AIRCRAFT TMS:_______ BUNO:_______ DATE OF INSPECTION:_______________

RANK	PARAGRAPH	DESCRIPTION	RATING OR DATA
____	8.5.2i	OVERALL CONDITION BOMB BAY	0 1 2 3 4 5 6 7 8 9
____	8.5.2j	OVERALL CONDITION FWD FS-1117	0 1 2 3 4 5 6 7 8 9
____	8.5.2j	OVERALL CONDITION AFT FS-1117	0 1 2 3 4 5 6 7 8 9
____	8.5.2k	OVERALL CONDITION APU PRES DECK	0 1 2 3 4 5 6 7 8 9
____	8.5.2l	OVERALL CONDITION LH HORIZ STAB	0 1 2 3 4 5 6 7 8 9
____	8.5.2l	OVERALL CONDITION RH HORIZ STAB	0 1 2 3 4 5 6 7 8 9
____	8.5.3	CONDITION OF FUSELAG EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.5.4	CONDITION OF FUSELAG PREV REPAIR	0 1 2 3 4 5 6 7 8 9
____	8.6.1a	CONDITION OF NLG STEERING SYSTEM	0 1 2 3 4 5 6 7 8 9
____	8.6.1b	CONDITION OF LH MLG	0 1 2 3 4 5 6 7 8 9
____	8.6.1b	CONDITION OF LH MLG	0 1 2 3 4 5 6 7 8 9
____	8.6.1c	CONDITION OF LH MLG DOORS/ LINKS	0 1 2 3 4 5 6 7 8 9
____	8.6.1c	CONDITION OF RH MLG DOORS/ LINKS	0 1 2 3 4 5 6 7 8 9
____	8.6.1c	CONDITION OF NLG DOORS & LINKS	0 1 2 3 4 5 6 7 8 9
____	8.6.1d	CONDITION OF NLG	0 1 2 3 4 5 6 7 8 9
____	8.6.2	NLG STEERING HOUSING	SEALNT OK THRDS OK TRHDS CRKD
____	8.6.3	SEVERITY OF LH MLG LEAKS	NONE 1 2 3 4 5 6 7 8 9
____	8.6.3	SEVERITY OF RH MLG LEAKS	NONE 1 2 3 4 5 6 7 8 9
____	8.6.4	CONDITION OF LH MLG EXPOSD CHROM	0 1 2 3 4 5 6 7 8 9
____	8.6.4	CONDITION OF RH MLG EXPOSD CHROM	0 1 2 3 4 5 6 7 8 9
____	8.6.4	CONDITION OF NLG EXPOSD CHROME	0 1 2 3 4 5 6 7 8 9
____	8.6.5	CONDITION OF LH MLG EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.6.5	CONDITION OF RH MLG EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.6.5	CONDITION OF NLG EXPOSED WIRE	0 1 2 3 4 5 6 7 8 9
____	8.9	OVERALL SUITABILITY OF AIRCRAFT FOR SERVICE PERIOD ADJUSTMENT	0 1 2 3 4 5 6 7 8 9 Suitable : Unsuitable

Enclosure (3)

ASPA INSPECTION RESULTS REPORT FORM

AIRCRAFT TMS:______ BUNO:________ DATE OF INSPECTION:________________

RANK	PARAGRAPH	DESCRIPTION	RATING OR DATA
___	8.3.1b	FUEL LEAKS TANK #5 AFT SPAR	0 1-2 3-5 5-8 8-10 11 OR MORE
___	8.3.1c	FUEL LEAKS TANK #5 ACCESS	0 1-2 3-5 5-8 8-10 11 OR MORE
___	8.3.1e	FUEL LEAKS TANK #5 BL-65	0 1-2 3-5 5-8 8-10 11 OR MORE
___	8.3.1g	FUEL LEAKS TANK #5 FILLETS	0 1-2 3-5 5-8 8-10 11 OR MORE
___	8.4.1a	CONDITION OF LH WING AFT SPAR	0 1 2 3 4 5 6 7 8 9
___	8.4.1b	CONDITION OF LH WING STORES FTG	0 1 2 3 4 5 6 7 8 9
___	8.4.1c	CONDITION OF LH WING FLAP TRACK	0 1 2 3 4 5 6 7 8 9
___	8.4.1d	CONDITION OF LH WING PLANKS	0 1 2 3 4 5 6 7 8 9
___	8.4.1a	CONDITION OF RH WING AFT SPAR	0 1 2 3 4 5 6 7 8 9
___	8.4.1b	CONDITION OF RH WING STORES FTG	0 1 2 3 4 5 6 7 8 9
___	8.4.1c	CONDITION OF RH WING FLAP TRACK	0 1 2 3 4 5 6 7 8 9
___	8.4.1d	CONDITION OF RH WING PLANKS	0 1 2 3 4 5 6 7 8 9
___	8.4.2a	CONDITION OF LH AILERON	0 1 2 3 4 5 6 7 8 9
___	8.4.2b	CONDITION OF LH AILERON TABS	0 1 2 3 4 5 6 7 8 9
___	8.4.2c	CONDITION OF LH WING FLAP	0 1 2 3 4 5 6 7 8 9
___	8.4.2d	CONDITION OF #1 TAILPIPE SHROUD	0 1 2 3 4 5 6 7 8 9
___	8.4.2d	CONDITION OF #2 TAILPIPE SHROUD	0 1 2 3 4 5 6 7 8 9
___	8.4.2e	CONDITION OF #1 NACELLE	0 1 2 3 4 5 6 7 8 9
___	8.4.2e	CONDITION OF #2 NACELLE	0 1 2 3 4 5 6 7 8 9
___	8.4.2f	CONDITION OF LH TRAILNG EDGE RIB	0 1 2 3 4 5 6 7 8 9
___	8.4.2g	CONDITION OF LH LEADING EDGE	0 1 2 3 4 5 6 7 8 9
___	8.4.2a	CONDITION OF RH AILERON	0 1 2 3 4 5 6 7 8 9
___	8.4.2b	CONDITION OF RH AILERON TABS	0 1 2 3 4 5 6 7 8 9
___	8.4.2c	CONDITION OF RH WING FLAP	0 1 2 3 4 5 6 7 8 9
___	8.4.2d	CONDITION OF #3 TAILPIPE SHROUD	0 1 2 3 4 5 6 7 8 9
___	8.4.2d	CONDITION OF #4 TAILPIPE SHROUD	0 1 2 3 4 5 6 7 8 9

Enclosure (3)

ASPA INSPECTION RESULTS REPORT FORM

AIRCRAFT TMS:_______ BUNO:________ DATE OF INSPECTION:________________

RANK	PARAGRAPH	DESCRIPTION	RATING OR DATA
____	8.4.2e	CONDITION OF #3 NACELLE	0 1 2 3 4 5 6 7 8 9
____	8.4.2e	CONDITION OF #4 NACELLE	0 1 2 3 4 5 6 7 8 9
____	8.4.2f	CONDITION OF RH TRAILNG EDGE RIB	0 1 2 3 4 5 6 7 8 9
____	8.4.2g	CONDITION OF RH LEADING EDGE	0 1 2 3 4 5 6 7 8 9
____	8.4.3a	CONDITION OF #1 NAC WIRE/TUBING	0 1 2 3 4 5 6 7 8 9
____	8.4.3a	CONDITION OF #2 NAC WIRE/TUBING	0 1 2 3 4 5 6 7 8 9
____	8.4.3b	CONDITION OF LH WING EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.4.3a	CONDITION OF #3 NAC WIRE/TUBING	0 1 2 3 4 5 6 7 8 9
____	8.4.3a	CONDITION OF #4 NAC WIRE/TUBING	0 1 2 3 4 5 6 7 8 9
____	8.4.3b	CONDITION OF RH WING EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.4.4	CONDITION OF LH WING PREV REPAIR	0 1 2 3 4 5 6 7 8 9
____	8.4.4	CONDITION OF RH WING PREV REPAIR	0 1 2 3 4 5 6 7 8 9
____	8.5.1a	OVERALL CONDITION OF AFT RING FT	0 1 2 3 4 5 6 7 8 9
____	8.5.1b	OVERALL CONDITION OF FOR RING FT	0 1 2 3 4 5 6 7 8 9
____	8.5.1c	CONDITION OF VERT FIN ATTCH FTG	0 1 2 3 4 5 6 7 8 9
____	8.5.1d	CONDITION OF FOR RH JACK/MOR FTG	0 1 2 3 4 5 6 7 8 9
____	8.5.2a	OVERALL CONDITION DOORS/ LINKAGS	0 1 2 3 4 5 6 7 8 9
____	8.5.2b	OVERALL CONDITION LH ELEVATOR	0 1 2 3 4 5 6 7 8 9
____	8.5.2b	OVERALL CONDITION RH ELEVATOR	0 1 2 3 4 5 6 7 8 9
____	8.5.2c	OVERALL CONDITION LH ELVATOR TAB	0 1 2 3 4 5 6 7 8 9
____	8.5.2c	OVERALL CONDITION RH ELVATOR TAB	0 1 2 3 4 5 6 7 8 9
____	8.5.2d	OVERALL CONDITION RUDDER	0 1 2 3 4 5 6 7 8 9
____	8.5.2e	OVERALL CONDITION RUDDER TAB	0 1 2 3 4 5 6 7 8 9
____	8.5.2f	OVERALL CONDITION CARRYTHROUGH	0 1 2 3 4 5 6 7 8 9
____	8.5.2g	OVERALL CONDITION BELLY CMPRT	0 1 2 3 4 5 6 7 8 9
____	8.5.2h	OVERALL CONDITION BATTERY SUPRT	0 1 2 3 4 5 6 7 8 9

Enclosure (3)

ASPA INSPECTION RESULTS REPORT FORM

AIRCRAFT TMS:______ BUNO:_______ DATE OF INSPECTION:______________

RANK	PARAGRAPH	DESCRIPTION	RATING OR DATA
____	8.5.2i	OVERALL CONDITION BOMB BAY	0 1 2 3 4 5 6 7 8 9
____	8.5.2j	OVERALL CONDITION FWD FS-1117	0 1 2 3 4 5 6 7 8 9
____	8.5.2j	OVERALL CONDITION AFT FS-1117	0 1 2 3 4 5 6 7 8 9
____	8.5.2k	OVERALL CONDITION APU PRES DECK	0 1 2 3 4 5 6 7 8 9
____	8.5.21	OVERALL CONDITION LH HORIZ STAB	0 1 2 3 4 5 6 7 8 9
____	8.5.21	OVERALL CONDITION RH HORIZ STAB	0 1 2 3 4 5 6 7 8 9
____	8.5.3	CONDITION OF FUSELAG EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.5.4	CONDITION OF FUSELAG PREV REPAIR	0 1 2 3 4 5 6 7 8 9
____	8.6.1a	CONDITION OF NLG STEERING SYSTEM	0 1 2 3 4 5 6 7 8 9
____	8.6.1b	CONDITION OF LH MLG	0 1 2 3 4 5 6 7 8 9
____	8.6.1b	CONDITION OF LH MLG	0 1 2 3 4 5 6 7 8 9
____	8.6.1c	CONDITION OF LH MLG DOORS/ LINKS	0 1 2 3 4 5 6 7 8 9
____	8.6.1c	CONDITION OF RH MLG DOORS/ LINKS	0 1 2 3 4 5 6 7 8 9
____	8.6.1c	CONDITION OF NLG DOORS & LINKS	0 1 2 3 4 5 6 7 8 9
____	8.6.1d	CONDITION OF NLG	0 1 2 3 4 5 6 7 8 9
____	8.6.2	NLG STEERING HOUSING	SEALNT OK THRDS OK TRHDS CRKD
____	8.6.3	SEVERITY OF LH MLG LEAKS	NONE 1 2 3 4 5 6 7 8 9
____	8.6.3	SEVERITY OF RH MLG LEAKS	NONE 1 2 3 4 5 6 7 8 9
____	8.6.4	CONDITION OF LH MLG EXPOSD CHROM	0 1 2 3 4 5 6 7 8 9
____	8.6.4	CONDITION OF RH MLG EXPOSD CHROM	0 1 2 3 4 5 6 7 8 9
____	8.6.4	CONDITION OF NLG EXPOSD CHROME	0 1 2 3 4 5 6 7 8 9
____	8.6.5	CONDITION OF LH MLG EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.6.5	CONDITION OF RH MLG EXPOSD WIRE	0 1 2 3 4 5 6 7 8 9
____	8.6.5	CONDITION OF NLG EXPOSED WIRE	0 1 2 3 4 5 6 7 8 9
____	8.9	OVERALL SUITABILITY OF AIRCRAFT FOR SERVICE PERIOD ADJUSTMENT	0 1 2 3 4 5 6 7 8 9 Suitable : Unsuitable

Enclosure (3)

APPENDIX B

A-6 LOCAL ENGINEERING SPECIFICATION

NAVAL AIR REWORK FACILITY
NORFOLK, VIRGINIA 23511

ADVANCE

Code NARF-322/DLM
Date: 30 APR 1985

TITLE: A-6 Local Engineering Specification

IDENTIFICATION/CLASSIFICATION: A-6 Rework/NO (01) 7183 Rev D

SUBJ: A-6E, KA-6D, and EA-6A Aircraft Service Period Adjustment (ASPA); inspection requirements for

REF: (a) NAVAIREWORKFAC Norfolk LES A-6 Rework/NO (01) 7183 Rev C
(b) NAVAVNLOGCEN INST. 4730.XX (DRAFT ASPA INSTRUCTION)
(c) NA 01-85ADF-4-1
(d) NA 01-85ADA-4-1

ENCL: (1) ASPA Evaluation Sheet
(2) ASPA Score Sheet
(3) Adjustment Criteria
(4) Zonal inspection guidelines

1. PURPOSE: To provide A-6E, KA-6D and EA-6A aircraft evaluation procedures which allow a depot field team to assess aircraft material condition and suitability for one 12 month increase to the original operating service period end date (PED).

2. CANCELLATION: Reference (a) is cancelled and superseded.

3. BACKGROUND: This directive has been prepared to provide a quantitative method for evaluating aircraft condition in accordance with the guidance of reference (b). The evaluation results in a numerical condition index which is indicative of the aircraft's overall material condition and which can be used to compare its condition with other aircraft of the same T/M/S. The P&E's evaluation of the individual discrepancies and the condition index is used to identify aircraft which can be prudently operated for another year without causing significant degradation in their maintainability, safety, or salvageability.

4. INSPECTION TEAM: The ASPA inspection team will be responsible for accomplishing the inspection requirements, reporting the results and providing repair cost estimates, and recommending aircraft suitability for 12 month PED increase. The ASPA inspection team will consist of a P & E, assisted by E & E personnel as required.

5. APPLICATION: This directive applies to all A-6E, KA-6D, and EA-6A aircraft requiring the first evaluation for an increase to their current PED. The inspection specified in this directive shall be accomplished by a depot ASPA evaluation team as directed by the NAVAVNLOGCEN. The ASPA evaluation is required during the six (6) month period prior to the PED of the affected aircraft, and is normally requested by the controlling custodian.

6. SPECIAL MATERIALS: None.

7. EFFECTIVE DATE:

8. INSTRUCTIONS:

NOTE

The examination outlined in this directive is intended to be performed at the aircraft reporting custodian's operating site. The disassembly and reassembly required for the evaluation is intended for accomplishment by the reporting custodian. The preparation directions in paragraphs 8.1 through 8.2.11 are also contained in the organizational level MRC decks.

8.1 Wash aircraft and make safe for maintenance.

8.2 Prepare aircraft as follows prior to inspection:

8.2.1 Open nose radome (access number 154).

8.2.2 Remove canopy.

8.2.3 * Spread wings.

8.2.4 *Fully extend flaps and slats.

8.2.5 Open wingtip speedbrakes.

8.2.6 Open forward engine bay doors, access number 26 and 107 (32 and 101 on EA-6A).

8.2.7 Lower extensible equipment platform, access panel number 204 (216 on EA-6A.

8.2.8 Remove B/N-EWO ejection seat and cockpit right hand console panels illustrated in reference (c) Figure 1-107, items 29 and 31 for A-6E BUNO 158041 and sub; and reference (d), Figure 1-61, items 8 and 12 for all other A-6E, KA-6D, and EA-6A aircraft. Remove cockpit center console panels illustrated in reference (c), Figure 1-106, items 135 and 141 for A-6E BUNO 158041 and sub; and reference (d), Figure 1-60, items 15 and 16D for all other A-6E, KA-6D and EA-6A aircraft.

8.2.9 Remove forward, mid, and aft fuselage fuel cell covers, access panel numbers 115, 116, and 117, respectively (111, 131, and 115 on EA-6A).

8.2.10 Open forward equipment bay doors (EA-6A only).

8.2.11 Open following access panels:

Panel No. A-6E/KA-6D	EA-6A	Description
111	106	L/H forward shoulder panel
112	108	L/H aft shoulder panel
16	17	Cooling turbine
15A, 60A	N/A	AN/ALQ Mid-Band Antenna Mount
57	58	Voltage regulator
48, 84	49, 85	Flaperon Cylinder Access
58	59	Combined system reservoir
88	91	Stabilizer attachment
89	92	ALQ-100/126 RCVR/XMTR access
122	121	Stabilizer actuator
161	162	Battery access
163	164	R/H aft shoulder panel
165	166	R/H forward shoulder panel
42	40	Stabilizer attachment
192	198	Rudder actuator access
174	178	Flap drive gearbox
119	117	Ram air turbine compartment
148	148	Slat drive gearbox access

*At start of inspection, flaps and slats will be extended and wings will be spread. External electrical and hydraulic power source is required during inspection to retract flaps, slats, speedbrakes, and to fold wings.

8.3 Utilize the ASPA Evaluation Sheet (enclosure 1.) to record the conditions found at each specified location on the aircraft. For each item circle the code which corresponds to the most serious defect observed, i.e., circle the leftmost code which applies. In addition, while

inspecting the aircraft, note any critical or major defects not addressed by the evaluation sheet. Record such items on the second page of the evaluation sheet. Enclosure (4) may be used as a guide for detecting miscellaneous discrepancies.

8.3.1 MAINTENANCE RECORD REVIEW: ITEM 1.

Review individual maintenance records with custodian assistance for indications of excessive corrosion control expenditures, wiring problems beyond squadron troubleshooting capability, and chronic fuel leaks. Note evidence of repeated gripes on landing gear, flight controls, environmental control system, or aircraft electrical power supply systems. Review logbook miscellaneous/history section (OPNAV 4790/25A) for unusual events such as exposure to salt water, fire extinguishing agents or other corrosive media.

8.3.2 FORWARD FUSELAGE : ITEMS 2., 3., 4., 5., and 6.

a. ITEM 2. Evaluate the nose radome for erosion (wear), delamination, corrosion of metal structure, dents, and misalignment.

b. ITEM 3. Examine intake duct leading edge for deterioration or badly worn (eroded) surface.

c. ITEM 4. Examine intake duct splitter boards for evidence of delamination or internal corrosion.

d. ITEM 5. Examine internal surfaces of intake duct for cracking, failed internal structure (oilcanning) or loose fasteners.

e. ITEM 6. Examine left and right boarding ladder latch mechanisms, including locking bushings, for evidence of wear, loose fasteners, misalignment or buckled structure.

8.3.3 COCKPIT: ITEMS 7., 8., 9., 10., and 11.

a. ITEM 7. Examine canopy glass for visibility obstructions, optical distortion, scratches, and crazing.

b. ITEM 8. Examine windshields for obstructions to visibility (delaminations, chips, cracks) , optical distortion, or scratches.

c. ITEM 9. Examine cockpit sloping bulkhead for evidence for structural corrosion.

d. ITEM 10. Examine windshield frame for evidence of external or internal corrosion.

e. ITEM 11. Examine cockpit deck under open consoles and B/N seat for corrosion.

8.3.4 UPPER FUSELAGE: ITEMS 12., 13., 14., 15., 16., and 17.

a. ITEM 12. Examine inboard wing walkway assemblies, top and bottom for evidence of delamination and previous repairs.

b. ITEM 13. Examine AC/DC relay box installation for corroded structure, corroded connectors, or deteriorated wire insulation.

c. ITEM 14. Examine upper portions of F.S. 227.25 bulkhead for cracking.

d. ITEM 15. Examine upper fuselage longerons for corrosion, particularly around nutplates.

e. ITEM 16. Examine fuselage tank top panels for cracking or corrosion.

d. ITEM 17. Examine battery compartment for corrosion.

8.3.5 ENGINE AREA AND WHEELWELLS: ITEMS 18., 19., 20., 21., and 22.

a. ITEM 18. Examine lower areas of F.S. 227.25 (forward main wheelwells) for cracking of lugs.

NOTE:

Aircraft found to have cracks or previous repairs at the F.S. 227.25 bulkhead will be allowed only one twelve month adjustment, assuming the overall aircraft condition is otherwise suitable for adjustment.

b. ITEMS 19. and 20. Examine visible portions of left and right hand keel areas for cracking, dents, and previous repairs.

c. ITEM 21. Examine forward and aft engine bay doors for loose (worn) hinges or latch mechanisms, buckled structure, misalignment, dents, and deteriorated seals.

d. ITEM 22. Examine forward and aft landing gear doors for loose (worn) bearings or linkages, buckled structure, misalignment, dents, and deteriorated seals.

8.3.6 LEFT & RIGHT WING PANELS: ITEMS 23., 24. and 34., 25. and 35., 26., 27., 28. and 29., 30. and 36., 31. and 37., 32., and 33.

a. ITEM 23. Examine the lower skin in the vicinity of W.S. 65 (fishmouth area) for evidence of corrosion attack. Keep in mind that any visible clues of corrosion here are usually indicative of a severe attack.

b. ITEMS 24. and 34. Examine lower wing skin of inner and outer wing panels in the vicinity of the wingfold actuator attachment fitting for any evidence of corrosion as evidenced by peeling, cracking, bubbled, or loose paint. Corrosion in this area usually originates around the heads of the large steel structural fasteners. Due to sealant and paint system, even minor clues here are usually indicative of a severe corrosive attack.

c. ITEMS 25. and 35. With slats extended, examine leading edge slat grooves and guides for any evidence of cracking or corrosion.

d. ITEM 26. Examine pylon wiring and connectors for deterioration.

e. ITEM 27. Examine fuel quantity feedthroughs in wing beams for any evidence of corrosion attack (visible in wheelwell).

f. ITEMS 28. and 29. To the extent possible, examine the left and right hand leading edge "bumps" (ALQ-126 antenna enclosures) for evidence of corrosion.

g. ITEMS 30. and 36., 31. and 37. Examine the inner and outer wing panel flap ribs for cracking and wear of the tracks and bearing surfaces. With the flaps extended, examine the trailing edges of the inner and outer wing panels for corrosion.

h. ITEM 32. Retract the flaps and slats and fold the aircraft wings. Examine the wingfold area for any evidence of deteriorated wiring or connectors. Such deterioration may include chafing, cracking of insulation, corrosion, bad connector potting, fluid damage, evidence of overheating, damaged splices, or damaged connectors.

i. ITEM 33. Examine the wingfold shear fittings between the hinge and lock fittings for corrosion. Also check wingskin around the edge of the lock fittings for corrosion. Again, any visible clues are usually symptomatic of severe corrosion attack.

8.3.7 AFT FUSELAGE AND TAIL: ITEMS 38., 39., 40. AND 41., 42., 43., 44., 45., AND 46.

a. ITEM 38. Examine left and right fixed tailpipe fairing installations for general deterioration, buckling, loose (failed) structure, cracks, or loose fasteners.

b. ITEM 39. Evaluate extensible equipment platform for loose (worn) hinges and alignment bushings, buckling, misalignment, dents, and deteriorated seals.

c. ITEMS 40. and 41. Examine lower portions of F.S. 451.5 bulkhead for cracking, particularly in the area of hook lift cylinder attachment. Also examine rivet rows in upper flange areas for cracking.

d. ITEM 42. Examine tailhook trough area for structural cracking, paying particular heed to "softness" which is indicative of failure in supporting structure.

e. ITEM 43. Examine horizontal stabilizer installation for evidence of excess mechanical play, cracking, failed internal structure, loose fasteners, or temporary repairs.

f. ITEM 44. Examine stabilizer wipe area for corrosion and cracking.

g. ITEM 45. Evaluate rudder hinges for excess wear (play).

h. ITEM 46. Examine vertical fin base for evidence of corrosion related delamination and previous repairs.

8.3.8 PAINT CONDITION: ITEM 47.

a. The exterior paint system (in conjunction with sealants) performs the function of protecting surfaces from the corrosive effects of the atmosphere. On all except the KA-6D aircraft, the paint also camouflages the form of the aircraft in flight.

b. Examine the exterior of the aircraft for paint condition using the following guidelines:

DESCRIPTION	QUALITATIVE CONDITION
Paint coverage complete. Few cracks on surface or rivet heads.	EXCELLENT
Some cracking on rivet heads, but most rivet heads covered. Very little peeling or evidence of large touched up areas.	GOOD
Many rivet heads partially bare. Some evidence of peeling, checking, or minor corrosion. Some large areas touched up or oversprayed.	FAIR
Paint oxidized with whitish cast. Numerous areas showing corrosion or major touch-up/overspray. More than 1/3 of surface has defects such as checking, bare spots, or peeling.	POOR

8.3.9 OVERALL CONDITION: ITEM 48.

This item should be marked after all the other items on the sheet have been evaluated. The evaluation includes this requirement in order to furnish an overall judgment of the condition of the aircraft which may not be addressed sufficiently by the specific indicators.

8.4 Evaluation Conclusions:

8.4.1 Provide a copy of all pages of the completed Evaluation Sheet (not the score sheet) to the reporting custodian.

8.4.2 The circled defects corresponding to each specific inspection must be transferred from the evaluation sheet to the score sheet. To do this for each item, mark the same column on the score sheet that is marked on the Evaluation Sheet. For example, for item 23 (LOWER SKIN-W.S. 65), if column 5 (Code F3) is circled on the Evaluation Sheet, then circle the number in column 5 on the score sheet. Notice that "Z" codes on the evaluation sheet do not need to be transferred since they indicate that no defect was observed. When all of the evaluation items on the score sheet have been marked or determined to have no defect, write the circled numbers in the "Score" column and add up the point score for the aircraft.

8.4.3 The ASPA inspection will uncover defects which can be used as an indication of the aircraft's overall material condition. If the aircraft's indicated condition is such that an additional year of service beyond the present PED would not be expected to cause a disproportionate impact in safety, maintainability, or cost of rework, then the ASPA evaluator shall recommend a service period adjustment. If, however, the aircraft's indicated condition is such that safety of flight might be compromised, structural failure is likely, portions of aircraft structure might become economically unsalvageable, or inordinate amounts of squadron maintenance man-hours might be needed during an additional year of service, then a service period adjustment recommendation is not warranted. Refer to enclosure (3) for additional criteria relating to service period adjustment.

8.4.4 Since the evaluation relies heavily on leading indicators for an assessment of the overall aircraft condition, the ASPA evaluation cannot be expected to produce a list of discrepancies, which if corrected, will permit a recommendation for service period adjustment to be made. The indicators are used to point to a high probability of hidden defects in the aircraft, therefore, if the indicators are repaired, any hidden defects still remain.

8.4.5 Discovery of major or critical defects requiring depot level repair, which are not leading indicators of other defects, will not affect the recommendation for service period adjustment provided in-service repair is feasible. In such cases, information concerning the defect(s) will be provided on the ASPA evaluation message. It should be noted that critical

defects, by definition, affect flight safety and must be resolved before the aircraft is even placed back in a flight status.

NOTE

Adjustment recommendations should not be contingent on organizational level correction of defects. A copy of the evaluator's list of defects noted during the inspection will be provided to the custodian for information purposes.

9. REPORTING:

a. The ASPA inspection team will forward a copy of the Evaluation sheet (all pages) to NAVAIREWORKFAC Norfolk (Code NESO-32230). A copy of the evaluation sheet (not the score sheet) shall also be provided to the aircraft custodian.

b. The Facility conducting the inspection shall notify the applicable controlling custodian point of contact of the evaluation results by telephone within 5 working days. Points of contact are:

COMNAVAIRLANT (Code 525) Autovon 564-2470
COMNAVAIRPAC (Code 721) Autovon 951-5761
COMNAVAIRESFOR New Orleans (Code 5720) Autovon 363-1220

c. The Facility conducting the inspection shall, within 10 working days, send the below listed information by means consistent with NAVOPS 049/85:

(If a message is not used, quote: "This is in lieu of a Naval message in support of the Naval message reduction initiative (NAVOP 049/85)."

(1) TMS/BUNO.

(2) PED.

(3) Tour.

(4) Total operating service months

(5) Total operating hours/this period.

(6) ASPA inspection date.

(7) ASPA inspection number (1st ASPA, 2nd ASPA, etc.)

(8) Number of manhours expended in the ASPA evaluation (Organizational/Depot)

(9) List of critical or major Depot level defects found.

(10) Identification of those critical or major defects which require depot resources, i.e., depot skills, equipment or facilities.

(11) Repair man-hour and turnaround time estimates for defects requiring depot level correction.

(12) Recommendation: A brief narrative as to the suitability of the aircraft for a 12 month adjustment to the present PED. Recommendations for adjustment are not contingent upon correction of defects.

(13) Report Distribution:

Action:

(a) Type Commander or Aircraft controlling custodian

(b) NALC-520

Info:

(a) Cognizant Field Activity

(b) Reporting Custodian

(c) Functional Wing

CG THIRD MAW -2
COMFAIRWESTPAC (724) -5
NAVSAFECEN
NAVPRO BETHPAGE -2
NERRA NAPLES IT
NAVAIRTESTCEN

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See attached PP & CD Release Statement

ADDITIONAL DISTRIBUTION
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322
62530 Data Rec & Dist V-88 -15
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A-6 ASPA EVALUATION

FACILITY:_____________ T/M/S:______ BUNO:________ TOUR:_____ PED:_______

INSPECT DATE:_________ TOT. OP. SER. MONTHS:_____ TOT. FLT HRS THIS PERIOD:_____

NO.	INDICATOR	LEVEL OF DEFECT COL: 1	2	3	4	5	6	7
1.	MAINTENANCE RECORD REVIEW			D	C	B	A	Z
2.	NOSE RADOME	P	O	E3	F3	R	Q	Z
3.	INTAKE DUCT FIBERGLAS					P	O	Z
4.	SPLITTER BOARDS				E2	E3	E5	Z
5.	INTAKE DUCT		M2	M3	M5	I	N	Z
6.	BOARDING LADDER LATCHES			H	N	Q	I	Z
7.	CANOPY GLASS		Y	X	J3	J5	S	Z
8.	WINDSHIELDS			Y	X	J3	J5	Z
9.	COCKPIT SLOPING BLKHD			F2	F3	F4	F5	Z
10.	WINDSHIELD FRAME			F2	F3	F4	F5	Z
11.	COCKPIT DECK			F2	F3	F4	F5	Z
12.	WING WALKWAYS	E1	E2	E3	E4	E5	L	Z
13.	AC/DC RELAY BOX		F1	F2	F3	V	U	Z
14.	BULKHEAD 227.25 (UPPER)			M1	M2	M3	M5	Z
15.	UPPER FUSE. LONGERONS			F2	F3	F4	F5	Z
16.	TANK TOP PANELS		M2	M3	F3	F4	F5	Z
17.	BATTERY COMPARTMENT			F2	F3	F4	F5	Z
18.	BULKHEAD 227.25 (LUGS)			M1	M2	M3	M5	Z
19.	L/H KEEL INSTALL.			M2	M3	R	L	Z
20.	R/H KEEL INSTALL.			M2	M3	R	L	Z
21.	ENGINE BAY DOORS		H	G	Q	R	W	Z
22.	LANDING GEAR DOORS		H	G	Q	R	W	Z
23.	LOWER SKIN-W.S. 65				F2	F3	F4	Z
24.	IWP LOWER SKIN-W.F. BOX				F2	F3	F4	Z
25.	IWP SLAT GROOVE		M2	M3	F3	F4	F5	Z
26.	PYLON WIRING				P	U	V	Z
27.	FUEL QUANTITY FEEDTHROUGHS			F1	F3	F4	F5	Z
28.	L/H LEADING EDGE "BUMP"				F2	F3	F5	Z
29.	R/H LEADING EDGE "BUMP"				F2	F3	F5	Z
30.	IWP FLAP RIBS				M2	M3	O	Z
31.	IWP TRAILING EDGE			F2	F3	F4	F5	Z
32.	WINGFOLD WIRING				P	V	U	Z
33.	WINGFOLD HINGE WEB PANELS		F1	F2	F3	F4	F5	Z
34.	OWP LOWER SKIN-W.F. BOX				F2	F3	F4	Z
35.	OWP SLAT GROOVE		M2	M3	F3	F4	F5	Z
36.	OWP FLAP RIBS				M2	M3	O	Z
37.	OWP TRAILING EDGE			F2	F3	F4	F5	Z
38.	FIXED TAILPIPE FAIRING	P	G	I	M	N	R	Z
39.	EXTEN. EQUIPMENT PLATFORM		H	G	Q	R	W	Z
40.	BULKHEAD 451.5 (LOWER)			M2	M3	M4	M5	Z
41.	BULKHEAD 451.5 (UPPER)			M2	M3	M4	M5	Z
42.	TAILHOOK TROUGH			M2	M3	M4	M5	Z
43.	HORIZ. STAB INSTALLATION		H	M3	I	N	K	Z
44.	STABILIZER WIPE AREA		M2	M3	F3	F4	F5	Z
45.	RUDDER HINGES						H	Z
46.	VERTICAL FIN BASE	P	E2	E3	E4	E5	L	Z
47.	PAINT CONDITION			D	C	B	A	Z
48.	OVERALL CONDITION			D	C	B	A	Z

BASIC DEFECT CODES

A - EXCELLENT
B - GOOD
C - FAIR
D - POOR
E - DELAMINATED (1-5)
F - CORRODED STRUCTURE(1-5)
G - BUCKLED
H - LOOSE (WORN)
I - LOOSE (FAILED STRUCTURE
J - SCRATCHED (1-5)
K - TEMPORARY REPAIR
L - PREVIOUS REPAIR (DEPOT)
M - CRACKED (1-5)
N - LOOSE FASTENERS
O - WORN SURFACE
P - BADLY DETERIORATED
Q - MISALIGNED
R - DENTED
S - CRAZED
T - CHAFED LINES
U - CORRODED CONNECTORS
V - CRACKED/DETERIORATED INSULATION
W - DETERIORATED SEALS
X - OPTICAL DISTORTION
Y - VISIBILITY OBSTRUCTION
Z - NO DISCREPANCY

DEFECT MODIFIER CODES

1 - SEVERE CONDITION, UNSALVAGEABLE
2 - REQUIRES ENGINEERED DEPOT REPAIR
3 - REQUIRES ROUTINE DEPOT REPAIR
4 - REQUIRES ORGANIZATIONAL REPAIR
5 - MINOR, REPAIR NOT REQUIRED

Enclosure (1)

A-6 ASPA INSPECTION SUMMARY			SHEET OF
T/M/S: (CIRCLE ONE) A-6E KA-6D EA-6A EA-6B	BUNO:	CURRENT PED:	CUSTODIAN:
NAME OF EVALUATOR:	DATE:		

DISC NO.	DISCREPANCY	CLASS			LEVEL		MAN-HRS TO CORRECT (DEPOT CR OR MJ ONLY)
		CR	MJ	MI	O	D	

ENCLOSURE (1)

DESIGNED ON CADOS 4

A-6 ASPA SCORE SHEET

FACILITY:____________ INSPECTION DATE:________ T/M/S:______ BUNO:________

Rank	Evaluation Item	Col: 1	2	3	4	5	6	Score
		Defect Weighted Points						
01	MAINTENANCE RECORD REVIEW			7	5	3	2	
02	NOSE RADOME	6	5	4	3	2	1	
03	INTAKE DUCT FIBERGLASS					6	3	
04	SPLITTER BOARDS				5	3	2	
05	INTAKE DUCT		12	10	7	5	2	
06	BOARDING LADDER LATCHES			9	7	4	2	
07	CANOPY GLASS	6	5	4	3	2	1	
08	WINDSHIELDS		6	5	4	2	1	
09	COCKPIT SLOPING BLKHD			7	5	3	2	
10	WINDSHIELD FRAME			8	6	4	2	
11	COCKPIT DECK			45	34	22	17	
12	WING WALKWAYS	38	32	25	19	13	6	
13	AC/DC RELAY BOX		29	23	17	13	6	
14.	BULKHEAD 227.25 (UPPER)			17	13	8	4	
15	UPPER FUSELAGE LONGERSONS			11	8	5	3	
16	TANK TOP PANELS		10	8	6	4	2	
17	BATTERY COMPARTMENT			6	4	3	1	
18	BULKHEAD 227.25 (LUGS)			18	14	9	4	
19	L/H KEEL INSTALLATION			16	12	8	4	
20	R/H KEEL INSTALLATION			15	11	7	4	
21	ENGINE BAY DOORS		8	6	5	3	2	
22	LANDING GEAR DOORS		8	6	5	3	2	
23	LOWER SKIN-W.S. 65				108	72	36	
24	IWP LOWER SKIN-W.F. BOX				98	65	32	
25	IWP SLAT GROOVE		55	44	33	22	11	
26	PYLON WIRING				14	9	4	
27	FUEL QUANTITY FEEDTHROUGHS			11	8	5	3	
28	L/H LEADING EDGE "BUMP"		10	8	6	4	2	
29	R/H LEADING EDGE "BUMP"		9	7	5	4	2	
30	IWP FLAP RIBS				8	5	3	
31	IWP TRAILING EDGE			7	5	3	2	
32	WINGFOLD WIRING				13	9	4	
33	WINGFOLD SHEAR PANELS		12	10	7	5	2	
34	OWP LOWER SKIN-W.F. BOX				24	16	8	
35	OWP SLAT GROOVE		22	18	13	9	4	
36	OWP FLAP RIBS				7	5	2	
37	OWP TRAILING EDGE			7	5	3	2	
38	FIXED TAILPIPE FAIRING	6	5	4	3	2	1	
39	EXTEN. EQUIPMENT PLATFORM	5	4	3	2	1	1	
40	BULKHEAD 451.5 (LOWER)			9	7	4	2	
41	BULKHEAD 451.5 (UPPER)			5	4	2	1	
42	TAILHOOK TROUGH			6	4	3	1	
43	HORIZ. STAB INSTALLATION		33	26	20	13	7	
44	STABILIZER WIPE AREA		26	21	16	10	5	
45	RUDDER HINGES						20	
46	VERTICAL FIN BASE	13	11	9	6	4	2	
47	PAINT CONDITION			71	53	35	18	
48	OVERALL CONDITION			108	81	54	27	

TOTAL SCORE:______

Enclosure (2)

Check one:

| | Aircraft is recommended for one year adjustment to PED.

| | Aircraft's general material condition does not warrant adjustment.

EVALUATOR:______________________________ DATE:________

Enclosure (2

A-6 AIRCRAFT SERVICE PERIOD ADJUSTMENT (ASPA) CRITERIA

1. A-6 ASPA is based on a relatively cursory inspection which looks for leading indicators of overall aircraft condition. Implicit in this approach is the realization that correction of leading indicator discrepancies does not improve the overall material condition of the aircraft. In other words, the aircraft should be judged suitable, or not suitable, for PED adjustment without assumptions that discrepancies identified by the ASPA evaluation will be corrected or even arrested. There are, however, two discrepancy categories found during ASPA evaluations for which the controlling custodian may request depot assistance:

a. Genuine Critical Discrepancies: By definition, critical discrepancies place an aircraft in a non-flying status regardless which maintenance level activity is required. Obviously, such discrepancies must be corrected before the aircraft can be routinely operated again, whether or not PED adjustment is indicated.

b. Depot Major Discrepancies Not Indicative of Overall Aircraft Condition: Discrepancies such as cracking damage of the tailhook well can occur at any time in the A-6E's service period and are not individually indicative of the aircraft's overall condition. Such discrepancies can be handled in the same manner as they would be during a regular P & E evaluation (providing they are isolated in nature).

2. A list of A-6 typical leading indicators would include, but not be limited to the following types of discrepancies:

* a. Paint deterioration evidenced by light, but widespread, corrosion attack on the aircraft skin.

* b. Corrosion or cracking of the wing leading edge slat groove.

* c. Intergranular corrosion of the cockpit deck.

d. Noticeable looseness or play in the horizontal stabilizer installation.

e. Extensive corrosion/cracking of stabilizer sweep areas on aft fuselage skin.

f. Repeated, intermittent problems with flight controls, environmental control system, or landing gear system.

g. Major delamination and/or corrosion of honeycomb assemblies such as intake splitter boards, walkways, and vertical stabilizer skins.

Enclosure (3)

* h. Intergranular corrosion of any primary structure such as wing planks, longerons, flap support ribs, bulkheads, machined attach fittings, wingfold shear webs, etc.

* Discrepancies are considered noteworthy. Refer to paragraph 4.C.

Evaluation of these types of discrepancies as indicators must include consideration not only of their present severity, but also the degradation which may be anticipated during the adjusted service period. In forecasting the amount of addition degradation which may be expected, the P & E should assume that the environmental, operational, and maintenance effects which are evident on the aircraft will continue. It is not realistic to expect that the degradation trends will be halted or reversed by the custodian as a reaction to the ASPA evaluation report.

3. Some examples of discrepancies which may not be indicative of overall aircraft condition but which the custodian may desire to have addressed are:

a. Isolated cracking intake duct inner skins.

b. Excessive wear of boarding ladder latch.

c. Worn rudder hinges/linkage.

d. Badly scratched/crazed pilot's windscreen.

e. Isolated cracking of fuselage skin in stabilizer sweep area.

f. Cracks in tailhook well.

Evaluation of these types of discrepancies as "non-indicators" is valid only if they exist as isolated discrepancies on an otherwise non-discrepant aircraft. For this reason, they are included as part of the composite quantitative process since in combination with other discrepancies, they can indeed indicate that the overall aircraft condition is not suitable for adjustment.

4. In making a decision to recommend a service period adjustment, the following information is provided for perspective:

a. The objective of determining that aircraft will not be a safety, maintenance, readiness, or economic casualty during an adjustment requires that an aircraft be in very good condition at the time of the evaluation. The discrepancies seen during the evaluation with paint and sealant intact should be minor indeed if the aircraft is to be operated for up to 21 months after the evaluation and yet be economically reworked at depot. An aircraft may, in fact, have no major or critical depot defects at the time of the evaluation and still not be suitable for adjustment. An aircraft which does not merit a recommendation for period adjustment does not represent a failure on anyone's part; it is simply a normal aircraft which has been operated in a very demanding operational and maintenance environment.

Enclosure (3)

b. Even though custodians may choose to have Depot correct discrepancies discovered during the ASPA evaluation, a recommendation for service period adjustment should not assume correction of any defects which are leading indicators. The objective is to recommend adjustment only if justified by the current material condition. If the aircraft requires significant man-hours and out of service time to correct depot level discrepancies, it is probably not an appropriate aircraft for service period adjustment. The evaluator should be extremely wary of an aircraft which exhibits depot defects requiring more than 250 man-hours or 10 workdays to correct.

c. The discrepancies identified with an asterisk in paragraph 2. are considered particularly noteworthy since this class of discrepancy normally does not occur as an isolated case on just one portion of the aircraft. One or more discrepancies of this nature are a clear indication that the aircraft should not be adjusted.

d. A correlation of point scores with adjustment results during initial evaluation of the quantitative method used in this document demonstrated that an aircraft with over approximately 300 points should not be considered a viable candidate for adjustment. Below 300 points, the merits of the specific discrepancies must still be considered, and the adjustment decision can still go in either direction. This premise is particularly true if noteworthy discrepancies are discovered which are not covered in the quantitative evaluation.

5. In summary, ASPA should determine if an aircraft is suitable for adjustment essentially as is. The depth of examination is not intended, and is not adequate, for determining what rework is necessary to make an aircraft suitable for PED adjustment. A list of all discrepancies found is provided to the custodian for information. Since the aircraft is evaluated without extensive disassembly and without stripping of paint and sealant systems, the level of discrepancies found during the evaluation should be minor indeed for aircraft which judged suitable for adjustment.

A-6 ZONAL INSPECTION

Although the evaluation procedure lists 48 specific tasks, it is desired that while the opportunity exists in an ASPA evaluation, all major and critical discrepancies be recorded. Discrepancies not addressed by the point system are still important in the adjustment decision, and are of considerable interest to the aircraft custodian. General guidance is provided below for types of discrepancies which should be recorded during the evaluation:

Transparent Assemblies: Scratches, cracks, crazing, delamination, defective sealant and seals, cracks in frames, corrosion, mechanical damage, and security.

Mechanical Linkages and Actuating Mechanisms: Cracks, corrosion, evidence of improper alignment and adjustment; bearings for wear, proper lubrication; evidence of interference/chafing, damage and security; and proper installation of rod end locking keys and tab washers.

Control Cables and Flexible Shafts: Corrosion, fraying, chafing, kinks, untwisting, broken strands/wires, evidence of improper alignment, rigging and tension, security and lubrication.

Pulleys, Fairleads, pressure seals, rubstrips, cable end fittings and conduits: Evidence of excessive wear, improper alignment, and adjustment, damage and security.

Flexible Hoses: Fraying, chafing, twisting, deterioration, proper routing and security, and evidence of leakage.

Tubing and Ducting: Cracks, corrosion and security, evidence of leakage, scorching adjacent to bleed air ducts, bellows distortion, and proper installation.

Electrical/Electronic Equipment: Evidence of overheating; corrosion, proper bonding and security; defective vibration dampeners; corroded or damaged pins (when disconnected), terminals and connectors, lockwiring, condition of junction boxes, conduits/tubing and legibility of essential markings.

Wiring and Wiring Components: Evidence of overheating; chafing, kinking, fraying, deterioration, fluid damage and proper routing; splices, terminals and connectors for damaged pins and deteriorated potting (when disconnected); security, and proper clamping.

Instruments: Evidence of overheating of electrical units; damaged faceplates, interface with moving parts, condition/security of units and attaching wiring, hoses and tubing.

General: Security, cracks, corrosion, damage, distortion, deformation, interface alignment, evidence of overheating or leakage, broken or missing parts, proper lubrication and bonding, and absence of debris.

Enclosure (4)

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